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ASPECTS OF INDUSTRIAL PRODUCTIVITY

ELSEWHERE in this issue (p. 789), a summary is given of the first report of the Committee on Industrial Productivity, under the chairmanship of Sir Henry Tizard. This report shows clearly the way in which the work of the Committee falls into the general pattern of the scientific effort of Great Britain. Its early work largely continued and expanded the work of the Research and Productivity Committee of the Advisory Council on Scientific Policy, and although now an independent body, the Committee is still closely linked with that Council and also with the Defence Research Policy Committee. Other links through its membership with the Federation of British Industries, the British Employers' Confederation and the Trades Union Congress indicate that in approaching a wide range of complex problems the Committee should be competent to advise on the ordering of the country's scientific and industrial effort where that is not already adequately secured. It is clear, too, that the Committee is alive to the importance of securing reasonable economy of manpower in the membership of new panels or *ad hoc* study groups, and that it is of set policy attempting to use the appropriate existing organisation, whether a Government department, a research institute or association, a professional institution or a university department, wherever possible, and is only creating new ones when absolutely essential.

In a general review, the term 'productivity' itself is discussed; it is used in the report in the sense of volume of output of a worker in a year in terms of goods or services. Emphasis is again placed on the urgent need for taking all possible steps to improve human co-operation and managerial efficiency if an immediate steep rise in productivity is to be achieved. The Committee's task, however, is essentially to supplement the efforts of other bodies, and possibly this has been responsible for a marked tendency in the report to suggest that problems of increased productivity, and in particular of the relations between research and development, can be solved by studies and admonitions by Government bodies or trade associations, rather than by action which provides the incentives which would make development worth while. Broadly, it is true that, as the report states, an immediate increase in the productivity of industry as a whole depends far more on understanding the implications of scientific advance and on the application of existing knowledge and known scientific methods than on the results of fresh research. Nevertheless, the Committee tends to overlook or under-estimate the importance of the economic factor, especially in its incentive aspect, and to ignore the vital point that what is required in many fields is primarily decision—and decision in matters where the scientific factors cannot be isolated from the economic or social factors.

Despite the *prima facie* evidence of the value of the Committee as a co-ordinating body, it is not possible to judge from this first report how far its work is going to be effective. The programme of

work is set forth in some detail, particularly in regard to the panels on technology and operational research and on human factors; but time will be required to show that the lines projected are really sound, and perhaps more especially in regard to the studies of human factors which affect productivity. Despite, however, many observations on the scientific factors affecting productivity, on the encouragement of scientific research and on the gap between discovery or invention and technical development, there are certain weaknesses; and only the panels concerned with the human factor and information services really show a scientific approach to their problems. The Panel on Technology and Operation...l Research appears to be unduly influenced by the belief that the problem of development can be solved by the establishment of a new development council, or by studies and admonitions of Government bodies or trade associations. There does not seem to be any lively sense that a real need is the provision of the appropriate incentive to make development worth while, and it is to be hoped that as the investigations of the Committee and its panels begin to mature, either the Committee itself or some of the numerous external organisations with which it is linked will stimulate some more fundamental and critical thinking and ask the vital questions.

It is, indeed, on the economic side that, despite its links with, and guidance from, the Economic Planning Board, the Committee appears to be weakest. This is most apparent in the inquiries of the curiously named Imports Substitution Panel, of which Prof. S. Zuckerman, professor of anatomy in the University of Birmingham, is chairman. The development of home resources of raw materials and the investigation of problems involved in reducing the dependence of Great Britain on imported raw materials, particularly from dollar sources, is a field in which economic and not scientific factors are and must be paramount. For this reason, it would have seemed more appropriate that this Panel should be headed by an economist. Indeed, despite the caution in the Panel's paragraph on economic considerations, the impression is left that where the Panel has entered the agricultural field and considered the question of grasslands expansion, nitrogenous fertilizers or pest control, for example, it has found itself out of its depth.

In these respects, this first report of the Committee on Industrial Productivity is disappointing; but it is too early to conclude that as its work proceeds it will not provide the imaginative and constructive criticism and recommendations required to point the way to a higher standard of industrial productivity. It is true that the whole burden of its terms of reference is for short-term rather than long-term results, but the short-term increase of productivity is a matter already of decisions—and of economic and political rather than scientific decisions. We need not on this present showing, however, abandon the hope that the next report of the Committee will give a bolder and more incisive lead, and show more of the clear thinking and decisive action that one is accustomed to expect from its present chairman.

FORM AND FUNCTION OF BIRD DISPLAY

Bird Display and Behaviour

An Introduction to the Study of Bird Psychology. By Edward A. Armstrong. Revised and enlarged edition of "Bird Display". Pp. 431+33 plates. (London: Lindsay Drummond, Ltd., 1947.) 21s. net.

SINCE the beginning of this century, the study of birds in the field has become increasingly popular, not only among amateurs but also among professional biologists. Though it started with detecting and distinguishing the different species, students gradually became more interested in the way of life of birds; they began to watch their behaviour, encouraged by the pioneer work of Howard, Selous, Heinroth and others. Attention was especially directed towards the often conspicuous preliminaries of pairing. Now, half a century later, a huge amount of data on bird behaviour is piled up in literature. In his book "Bird Display and Behaviour", which is a second edition, Mr. E. A. Armstrong has made an attempt, in many ways successful, to bring together the extensive literature dealing with bird display, and he provides a bibliography of nearly forty pages.

There are two ways, I think, of surveying the descriptions of courtship and other kinds of display in many different bird species. One is to break down in every case the sequence of display activities into its single components, to find out how these components are linked together and what is the function of the single elements as well as their linkage.

It is likely that in this way one will be able to find and understand different types of pairing, and this method can become the skeleton of the survey. However, this kind of survey is only possible when the authors of the original papers, when writing down their observations, also have analytical purposes in mind. It is a pity that this is very often not the case, and that is probably the reason why Mr. Armstrong chose the other way of discussion. He takes together, and considers in separate chapters, those elements in the behaviour of different bird species that have a similar appearance, for example, courtship feeding, ceremonial gaping, greeting ceremonies, mutual ceremonies, social ceremonies, dances, arena displays and song. Sometimes interesting comparisons are made with behaviour in other animals and men; comparison of the dances of birds and man, especially, leads to some very striking facts.

That Mr. Armstrong himself feels that one cannot stop at classifying the descriptions but that one wants to understand the meaning, the way of functioning and the origin of the display activities, follows from the chapters on the significance of display, on the relationship between the physiological and psychological aspects of display and on displacement reactions. The possible origin of the display activities is also considered in the chapters on disablement reactions and distraction display. In separate chapters Mr. Armstrong deals with problems of social hierarchy, dominance and territory. As is illustrated by the chapter on the function of emotion in behaviour, Mr. Armstrong does not fully agree with the school of objectivistic behaviour study (Lorenz, Tinbergen). But in contrast to many other students who approach the problems of animal behaviour from the psycho-

logical point of view, he appears to know the work of the objectivistic school quite well; and he does not hesitate to work up its results in his personal view, and so form the leading thread that runs through the whole book.

Because of the great many carefully annotated facts, the book is not easy to read. But by this very collection of facts Mr. Armstrong has rendered a great service to everyone who wants to study bird display more thoroughly. In addition, he has made this book a valuable introduction for those who want to know more about the theoretical background of behaviour study.

G. P. BAERENDS

ADVANCES IN PROTEIN CHEMISTRY

Advances in Protein Chemistry

Edited by M. L. Anson and John T. Edsall. Vol. 4. Pp. ix + 575. (New York: Academic Press, Inc.; London: H. K. Lewis and Co., Ltd., 1948.) 8.50 dollars.

VOLUME 4 of "Advances in Protein Chemistry", like previous numbers in the same series, forms a welcome addition to works of reference in a continuously expanding field of research. Reviews are not written for experts; but they should act as guidance to workers in allied fields and should stimulate interest in the subject under discussion. Such articles should be readable and interesting without recourse to references; the latter should, of course, be available for the more specialized reader, but should not be required for an understanding of the text. Most of the articles in the volume under discussion meet these criteria, though, of course, some subjects, such as "The Plasma Proteins in Disease", do necessarily involve the enumeration of a very large number of references to experimental observations. The present volume covers a wide range of subjects, which is indicative of the variety of problems with which workers in the field of protein research are confronted.

The study of "Protein Gels" can give information about the external structure of the constituent protein molecules, it can give data on the mechanical properties and structure of the gels as a whole, and it can show what influence short- and long-range intermolecular forces can have upon molecular interaction. J. D. Ferry gives a very detailed description of most of the experimental data available, though, considering the volume of the literature concerning gelatine gels, it is not surprising that quite a few papers on the subject are not mentioned in the review. Experimental data are discussed without going into the details of the many speculations, which are now current, about intermolecular forces. The main emphasis of the review is on mechanical, kinetic and chemical properties of gels. I think that renewed thermodynamic studies of equilibrium properties of gels could give much valuable information. The lessons learned from recent theoretical and experimental investigations on solutions of rigid and fibrous large molecules could be applied.

Recent studies on "The Interaction of Proteins and Synthetic Detergents" are reviewed by F. W. Putman. Results of investigations in that field can contribute greatly to our knowledge of protein structure and reactivity. Unfortunately, these systems are so complex that much more experimental data of great accuracy are needed before any unambiguous conclusions can be drawn. Putman's article contains references to most of the relevant papers, and he describes some of the hypotheses which can be built upon the results contained in them.

All but two of the articles in this volume of "Advances in Protein Chemistry" deal at least in some way with the structure of proteins or methods of their study. The two exceptions are articles on "Proteins of Pathogenic Bacteria" by A. M. Pappenheimer, jun., and "The Plasma Proteins in Disease" by A. B. Gutman. These are both very informative reviews; but the authors are somewhat handicapped, as the scope of the book would not allow them to give any very detailed account of the immunological studies which obviously have great significance in the subjects under discussion. Gutman's article gives a much-needed summary of electrophoretic studies on pathological sera which have been published in such large numbers since Tiselius's great improvements of the method for electrophoretic analysis in 1937. The short description of techniques for the fractionation of plasma into its various compounds is also valuable.

H. Svensson reviews the methods for "Preparative Electrophoresis and Ionophoresis". Electrical methods have proved very powerful in the analysis of protein mixtures and of heterogeneous degradation products of proteins. Recently, many procedures for the separation and preparation of electrically homogeneous fractions have been developed. Svensson describes all the methods available in sufficient detail to help the potential user in his choice of a suitable apparatus for his particular problem. This article should be of great value to many workers.

A. Neuberger's comprehensive review of the "Stereochemistry of Amino Acids" and R. B. Corey's interesting essay on "X-ray Studies of Amino Acids and Peptides" should act as mutual stimulants for chemists and X-ray crystallographers, the former giving a good picture of the information about the structure of amino-acids and peptides so far available, and also indicating many problems which could most usefully be investigated by crystallographic methods. Corey's article gives a realistic picture of the known facts about the internal structure of protein molecules. As the author points out, the molecular structure of proteins can be studied crystallographically either by investigations made directly on protein crystals or fibres or by investigations on amino-acids and peptides from which the protein molecules are built up. The former mode of attack has yielded definite data on molecular shape, hydration and packing, but has so far only given inferential information about the internal structure of protein molecules. The main theme of Prof. Corey's article is the discussion of the structures of some amino-acids and peptides which have been determined accurately by X-ray studies. He does, however, make some suggestions about the structure of protein molecules and the intra- and intermolecular forces and linkages involved.

The last article in the present volume is by J. Wyman, jun., who writes about "Heme Proteins". This is almost a monograph; it contains 120 pages, and is certainly of great value to all those who are interested in the study of hæmoglobin and other respiratory pigments by physico-chemical methods. Both the molecular constants of heme proteins and the physical bases of their reactions are discussed in great detail. It is to be hoped that this review will

stimulate much careful thought and experimental work, as it shows how many problems about these compounds and the reactions in which they are involved remain to be solved. The author is usually fair in describing many different hypotheses, though it is sometimes not quite clear why he favours one rather than another.

The publishers and editors are to be congratulated on the production of another well-printed and attractive volume. A uniform quoting of references might be adopted with some advantages. Errors appear to be few; I detected an error or omission of a reference quoted in page 7, and the diffusion constant quoted on page 434 should be $D_{20} = 6{\cdot}5 \times 10^{-7}$. This book should be a great help to workers in all branches of biochemistry and should also be a source of ideas and topics of research for physical chemists.

HERBERT GUTFREUND

GRAIN STORAGE IN BRITAIN

The Scientific Principles of Grain Storage

By T. A. Oxley. Pp. v+103. (Liverpool: Northern Publishing Co., Ltd., 1948.) 8*s*. 6*d*.

THE storage of cereals is a subject which has engaged human ingenuity for a very long time; its practice is therefore still governed in part by traditions which have grown up in varying circumstances of climate in different parts of the world. The literature of the subject is accordingly scattered and ill-adapted for co-ordination, partly because of the limited application to local conditions of many individual contributions. Furthermore, since much of the knowledge is in the possession of those who are neither trained to assemble their findings according to the scientific method nor to the habit of making them public, it is perhaps not surprising that generalized studies are few and far between. Mr. T. A. Oxley's contribution is therefore to be welcomed as a considerable addition to published knowledge, and the more so since it comes at a time when the annual tribute paid to rodents, insects, moulds and bacteria, currently estimated at ten per cent, can so ill be spared from the world's stock.

As its title suggests, the book is an account in scientific terms of facts concerning grain storage and does not involve any detail concerning application to practice. Though this method of presentation enables, in part, wide generalization to be made, it is perhaps not unfair to say that the book lacks some of the comprehensive nature suggested by its title, in so far as it deals in the main with two aspects of grain storage that are of particular interest in Great Britain.

The first concerns the preservation of grain harvested in an unstable condition by reason of too high a water content, a subject which becomes of greater importance year by year as the use of the combine harvester becomes more widespread in Great Britain. The second concerns the recognition and control of insect infestations, which in British experience are largely the result of importation.

The facts concerning insect infestation may doubtless be successfully sought elsewhere and in greater detail, as, for example, in the recent publication by Freeman and Turtle, "The Control of Insects in Flour Mills". On the other hand, it would be difficult to parallel the study which Mr. Oxley offers of the physics of grain in bulk and of the deductions which he draws from the thermal data available. It is in this particular field that the book excels and in which it is greatly aided by the clarity and brevity of style which the author brings to it. Doubtless the fact that much of the work on which he draws is his own in origin contributes to its success.

Since this book was written (it is dated August 1947), development has taken place in some of the matters it describes; for example, the use of pre-heated air for the drying of grain in bins has benefited from further study. No doubt in a later edition not only will such subjects be more fully described, but also the scope of the book will be enlarged to cover the problems of grain storage under tropical and sub-tropical conditions, where probably the greatest economies in the conservation of grain can be made.

It would not be difficult to cavil at minor points of fact and emphasis; to do so, however, would serve no useful purpose and might prejudice the very warm welcome that this useful book deserves.

E. N. GREER

PRINCIPLES OF STATISTICAL INFERENCE

Theory of Experimental Inference

By C. West Churchman. Pp. xi + 292. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1948.) 21*s*. net.

THE first duty of a reviewer is to say what his book is about; but that is not easy here. The title suggests to a British reader that the work will be cognate with that of Harold Jeffreys and with the later writings of Bertrand Russell. But neither of these writers is mentioned, nor does the author show any signs of being aware of their existence. Again, in his preface the author says that "we are making the much stronger claim" (and it is, indeed, a startling claim) "that the science of ethics (like all the principal branches of science) is *basic* to the meaning of any question that the experimental scientist raises". But I have not found a word in the book concerned with what is called ethics by the plain man; it seems to be taken for granted that all problems of value are ethical, so that there is no distinction between the good, on one hand, and the true or the beautiful, on the other. The author's thesis is then still startling; for experimental facts have often been distinguished from other things on the ground that they are free from the differences of opinion that attend all judgments of value. And it is still not immediately clear how his discussion bears on his thesis.

The first chapter of the book expounds the elements of statistical theory, as it has been developed by such men as Karl Pearson and R. A. Fisher; the second discusses the application of this theory to experimental inquiry. The treatment here is completely dogmatic; no sort of reason seems to be adduced for believing that the theory is in any sense true, or the method based on it valid in any sense relevant to experimental investigations. The author appears to hold that all other doctrines must be judged by their conformity with Pearson–Fisher statistics rather than conversely. On this basis he finds that the recognized systems of philosophy differ primarily in their view whether facts are logically prior to laws or vice versa. The discussion of these systems, professedly on this view, occupies the central and main part of the book;

actually, much of it is scarcely distinguishable from what would be expected in any university course of lectures on general philosophy. Finally, more particular problems are introduced, until the last chapter is a not very abstruse exposition of statistical 'quality control' in manufacture, which attracted so much attention during the War.

Of course, Mr. C. W. Churchman will consider this a caricature of his book, and say that I have ignored all the ideas to which he attributes most importance. If so, the error is due to genuine misunderstanding and not to malice; he should consider whether his own heed and respect for the views of others entitle him to complain. Surely he can scarcely be really ignorant that there are alternatives to the frequency theory of probability; that facts and laws have been held to be mutually defining, so that neither can be prior to the other; and that to some people his 'ideal' of errorless measurement is as sensible as the ideal of a round square. But if he allowed any trace of such discrepant doctrines to intrude, most of what he has written would have to be completely transformed.

The chief interest of Mr. Churchman's book is that it represents the extreme of a tendency that has been growing ever since the present sceptical generation (apart from the Marxists) abandoned all hope of a universal philosophy; philosophers tend to segregate into groups, distinguished, not by the answers that they give to questions of universally recognized urgency, but by the questions they ask, which have usually developed from a single focus in a narrow direction. The practice has the advantage that any question that once engages the attention of a group of experts may hope to receive a definite solution; doubtless the pupils and associates of E. A. Singer, jun., regard this work as a very serious contribution to knowledge; and it might have a wider audience if it had a less wide title. But the practice has the disadvantage that questions which, from their very nature, are unlikely to attract experts—for example, the treatment of certain topics in the text-books on which we have all been reared—receive no attention at all; it becomes increasingly difficult to convince those who approach science from the outside that it has any general principles which could form the basis of a cultural education. NORMAN R. CAMPBELL

EUROPE AND HER PREHISTORY

The Dawn of European Civilization

By Prof. V. Gordon Childe. New (fourth) edition, enlarged and completely rewritten. Pp. xix + 362. (London: Kegan Paul and Co., Ltd., 1948.) 28*s*. net.

PROF. V. G. CHILDE has done very well to bring out, so soon after the seven-year interruption by war of contact with archæology in the Continent of Europe, this revised fourth edition of the book with which he first made his name in 1925. Little of importance has escaped him of the material published since the 1939 edition, and the book stands up as well as ever it did to the responsibility of being the standard English summary of the first half of the 3,000 years of prehistory which lie, in Europe, between the early Neolithic and the Roman Empire. The whole 1939 text has been reconsidered, and much of it rewritten; there are many new (and better) illustrations, and at the end a set of new chronological tables as well as of compendious maps. The first chapter, on the Mesolithic hunters and fishers over whom the 'dawn of civilization' from the East gradually broke, is perhaps rather constricted, and the geological and palæobotanical elucidation of its chronology rather curtly sketched; but that, of course, is 'background' only. With the 'Neolithic revolution' to food-producing economy in the Near and Middle East the unfolding of the 'dawn' begins; Childe pursues it, as in his previous editions, by the method of taking each of the chief geographical regions of Europe in turn, and running through the sequence of its cultures from the first Neolithic to the beginning of the Middle Bronze Age, or the fifteenth century B.C., and then starting again upon the next one.

He begins with Crete—though without dwelling on the details of Minoan civilization once fully developed. It could be argued that Evans's belief in its "essentially European" character (pp. 20, 27) is now somewhat undermined by discovery in south-west Asia; the Minoan achievement was, indeed, uniquely blended, but the spread of Neolithic culture from the Ægean and the Straits into Continental Europe, on the other hand, shows its Asiatic heritage undergoing a progressive 'Europeanization' of a more objectively determinable kind, through a blending with the traditions of the Mesolithic Europeans. For, though until then not civilized at all, they showed themselves capable of combining together new 'civilized' and old 'savage' elements of culture, to produce a wide and self-assured range of 'barbaric' variations. Thus the 'dawn of European civilization' really means the morning of European barbarism; and beyond question, the most valuable contribution of Childe's book to the materials for a philosophy of history is his demonstration, built up by patient steps and culminating in the final "Retrospect", that its effect was to produce a *zoning* of cultures, in a descending scale of attainment from south-east outwards to north-west and north.

Thus, literate urban culture was already two thousand years old in Babylonia when it got its first foothold, in Mycenean Greece, on the European mainland; yet much of Europe was still then not yet in the Bronze Age. It was, of course, the same zoning that left the British Isles and Scandinavia still in the Bronze Age when Athens had already the Æschylean drama; and to it, in no small degree, is due the variety and vitality of the European genius, which has never been dulled by the spectacle of any universal uniformity of culture. That these things should now be attaining recognition among writers of general history (who are usually, and perhaps pardonably, about twenty years behind the specialists) is largely to be put to Childe's own credit; and if his fellow-specialists can still whisper that he is too apt to seem timid or perverse on points of detail, they know very well that without what they have learnt from him themselves they would scarcely be able to criticize him intelligently at all.

Since prehistory is not a natural science, but rather a social-historical study, scientific in some but not all aspects, there will always be a distinctive place in it for private judgments. Childe is sometimes chary of letting his be known. Virtuously resolved to be 'scientifically' free from bias, he will shrug away from puzzles with a gloomy exclamation-mark; he even ends the last sentence in the book with one. But there are still few other prehistorians whose private judgments, virtuous or otherwise, anyone really wants to hear. C. F. C. HAWKES

The Labile Molecule

(Discussions of the Faraday Society, No. 2, 1947.) Pp. ii+409. (London and Edinburgh: Gurney and Jackson, 1948.) 30*s*.

AT the present time there is a great deal of activity in the field of chemical kinetics in unravelling the complexity of those reactions which are believed to proceed by the intervention of free radicals both in the liquid and in the gas phase. Once more the Faraday Society has, at an opportune time, held a full-dress discussion of a subject that is not merely fashionable, but is also in full flight of the vigour of its development. Just as many of the Faraday Society discussions tend to become works of reference and inspiration for further work, so too does the present volume fall into this category. It is to be seen, well thumbed, in most laboratories having an interest in chemical kinetics.

It is not possible in a limited space to deal with any of the individual papers, but perhaps the dominant role is the emphasis on the more quantitative aspects of the subject. This is illustrated in a number of papers dealing with a variety of reactions where the energies of activation and temperature-independent factors for a number of radical-molecule processes have been determined with considerable precision. The discussion is first devoted to a theoretical treatment of the structure and behaviour of free radicals. Then follows gas-phase free radical reactions developed to a much more complete stage in the last ten years. Now, however, interest is perhaps greater in the liquid phase, and, in spite of much complexity, the papers reveal the very substantial progress made in analysing both oxidation reactions and polymerization. It is perhaps a pity that the publication of this important discussion has been so long delayed—it was held in September 1947.

Précis des découvertes somiologiques ou zoologiques et botaniques

Par C. S. Rafinesque. (Palerme 1814.) Reprint. Foreword by Prof. E. D. Merrill. Pp. iv+58. (New York: Peter Smith, 1948.) 4 dollars.

CONSTANTINE SAMUEL RAFINESQUE was born at Constantinople in 1783, and died in great poverty at Philadelphia in 1840. His father was French and his mother German. In 1802 he settled in America, where he studied biology in fifteen States of the Union. He was a keen explorer and an inspired collector, and, as a person, the history of biology can scarcely produce a more picturesque and eccentric figure. There was an unmistakable dash of genius in his composition, although he could be an unreliable and erratic worker. His death was a relief to his more matter-of-fact and orthodox contemporaries, and for a long time his works were allowed to drop out of the literature of biology. Later, however, a resumed study of his writings, which had in the meantime become very scarce and difficult to consult, validated many of his taxonomic discoveries, and some of his works were reproduced in facsimile.

The present volume is a photographic reprint of a publication of 1814, now regarded as indispensable to taxonomic students of both animals and plants. As many as 189 new species are described in it, and several new genera are instituted. Since only six copies are known to exist in American libraries, the reprint now reviewed became necessary, other works of Rafinesque having already been issued in a similar form. In 1942 the Transylvania College, where Rafinesque had been professor of biology for six years, produced a volume of unpublished and other Rafinesque material in commemoration of the centenary of his death. The re-issue of such notable and rare published memoirs is a benevolent undertaking, and the enterprise of the publishers of the 1814 volume is therefore gratefully commended.

F. J. COLE

Fundamentals of Photographic Theory

By Dr. T. H. James and Dr. George C. Higgins Pp. vii+286. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1948.) 21*s*. net.

THIS book is a condensed version of "The Theory of the Photographic Process", by Dr. C. E. K. Mees, and it should prove a valuable text-book for those possessing the requisite knowledge of physics and chemistry and the necessary photographic experience to apply this knowledge. The chapter on the photographic emulsion is somewhat meagre, but succeeding chapters on the formation of the latent image and on reciprocity-law failure and other exposure effects are good. As one would expect, the chapters on development (mechanism of development, composition and reactions of developers, and general kinetics of development) reflect the fact that Dr. T. H. James has for many years made valuable contributions to this subject. After a discussion of fixing and washing, the authors devote three excellent chapters to a study of sensitometry, and a further chapter to the theory of tone reproduction. New material published since the date of Dr. Mees's work is included, and the discussion in chapter 11 on the new speed constants adapted by the American Standards Association is of particular interest. Finally, the authors deal with the structure of the developed image and with sensitizing and desensitizing. The book is very free from errors for a first edition; the only one worth noting is that the formulæ on p. 103 are not quite correct. The index is adequate, and the printing, lay-out and paper are first-class.

Organic Reactions

Edited by Roger Adams. Vol. 4. Pp. viii+428. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1948.) 36*s*. net.

THE series issued under the title of "Organic Reactions", with Prof. Roger Adams, of the University of Illinois, as editor-in-chief, quickly established itself as a standard source of reliable and comprehensive accounts of the more important type reactions of organic chemistry. These accounts are both critical and capable of rapid application in the laboratory, and as such are great time-savers in organic chemical research work. The fourth volume follows the general plan of its predecessors. The articles, written by experts with first-hand knowledge of the reactions in question, deal with the Diels–Alder reaction, the preparation of amines by reductive alkylation, the acyloins, the synthesis of benzoins, the synthesis of benzoquinones by oxidation, the Rosenmund reduction of acid chlorides to aldehydes, and the Wolff–Kishner reduction. There are accompanying tables of specific compounds which are shown in the literature as having been prepared by or subjected to the reactions concerned. As usual, the volume has been produced in first-class style. It can be commended unreservedly to research workers in organic chemistry and to advanced students of the subject.

JOHN READ

COMBINED CHEMICAL AND BIOLOGICAL CONTROL OF INSECTS BY MEANS OF A SYSTEMIC INSECTICIDE

By Dr. W. E. RIPPER, R. M. GREENSLADE and L. A. LICKERISH
Pest Control, Ltd., Bourn, Cambridge

BIOLOGICAL control as a supplement to chemical control of insect pests was discussed by the first-named author in an article in *Nature* in 1944[1]. It was shown that there was a practical possibility of utilizing the predators and parasites of a pest species by controlling the pest with a selective insecticide. A selective insecticide was defined as a chemical which is toxic to pests but which does not kill the natural enemies of pests—the predators and parasites.

Certain insects, notably aphides, can reproduce so rapidly that a serious re-infestation of a treated crop can build up from the small number of pests which inevitably escape the effects of the insecticide, even though the mortality at the time of treatment is very high. A general insecticide, however effective, will kill most of the parasites and predators as well as most of the pest insects. Volterra[2] has stated in his "Third Law of the Disturbance of the Averages" that when a host species and its parasite are artificially reduced in proportion to their numbers, then the number of individuals of the species that is destroyed increases and that of the parasite species diminishes. If, therefore, a high mortality of the pest is achieved and an equal percentage of beneficial insects is killed, then, according to Volterra, an even higher infestation by the pest will result. Many a grower has learned this truth to his cost after having expended considerable sums on control work, only to suffer loss of crop through re-infestation.

In the work described in 1944[1], nicotine vapour was used as a selective insecticide. Predaceous Coccinellids, Syrphids and Chrysopids and parasitic Hymenoptera were shown to be quite unharmed by the short exposure needed to kill aphides, and the ratio of pests to beneficial insects was so altered that the latter had no difficulty in clearing up the remainder of the aphides and dealing effectively with new arrivals. Extensive quantitative experiments against cabbage aphis populations showed Volterra's principle to be correct, and showed also the possibility of supplementing chemical control with biological control. Excellent control of aphis lasting for three to six weeks resulted, protecting the crop through the period of possible re-infestation.

This method of control with nicotine vapour is now a commercial practice and is very effective; but, since nicotine is not persistent, it is necessary that a considerable population of both predators and aphis should be present at the time of treatment. If the real crop damage is caused by a virus transmitted by the aphis, then nicotine vapour is not effective, and it becomes necessary to use an insecticide with a comparatively long residual effect which can be applied very early, before the crop is thoroughly infested.

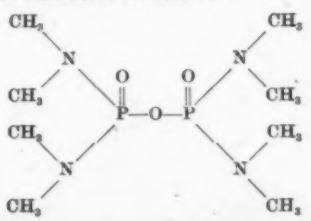
Some of the greatest agricultural losses are to-day caused by virus diseases. Considerable research work has been done on the plant pathological aspect of this problem; some progress has been made towards a solution by plant breeding, and practical virus control has been achieved in certain cases. A speedier and, therefore, more promising line of attack lies in the control of the vectors; but a persistent insecticide is required. Most persistent insecticides—D.D.T., benzene hexachloride, 'Parathion'—are not selective, and a more promising line of approach seemed to be by means of a systemic selective insecticide.

Systemic Insecticides and their Action

Systemic insecticides have been defined as insecticides which are carried in the sap-stream of plants and thus make such plants poisonous to insects, even in parts of the plant which are not reached by the spray. An analogous phenomenon is known in the field of weed-killers in the translocated weed-killers, by which is meant those herbicides which are transported in the sap-stream from the sprayed parts of the plants to other parts. The ideal aphis killer should be able to kill without coming into direct contact with each individual aphis, because these insects frequently live in curled and crinkled leaves and similar inaccessible and protected places. The three groups of insecticides with outstanding systemic actions are selenium compounds, organic fluorine compounds, and organic phosphorus compounds.

Selenium compounds are so toxic to man that their use as insecticides is out of the question, and our present-day knowledge of the fluorine-containing compounds is, perhaps, too incomplete to permit their use with safety on food crops. Attention was therefore focused on less dangerous and therefore more useful organic phosphorus compounds which show considerable systemic effects but are not more toxic than many previously used insecticides[3,4].

The most promising of these chemicals were tested from the point of view both of the control of pests and survival of the beneficial insects. It was soon discovered that one compound combined, to an outstanding degree, systemic and selective properties. This was *bis*(*bis*dimethylaminophosphonous)anhydride. The structural formula is:



The name of the compound is based on the proposed new method of nomenclature of the phosphorus-containing acids as suggested by Dr. B. C. Saunders. This method gives the pentavalent phosphorus acid the endings '-oric', '-onic', '-onous', and the trivalent ones the endings '-orous', '-inic', '-inous'.

The compound *bis*(*bis*dimethylaminophosphonous)-anhydride was originally prepared by Schrader and is (when pure) a colourless viscous liquid having a very slight characteristic odour and a taste similar to black pepper.

The physical properties are as follows: specific gravity, 25°/25° C., 1·24; boiling point, 154° C., at 2 mm. mercury pressure. It is miscible with water in all proportions and is soluble in most organic solvents, including ketones, nitriles, esters, aromatic hydrocarbons and alcohols. It is insoluble in the higher aliphatic hydrocarbons. Chemically it is fairly inert. It is not hydrolysed by water or alkali, but hydrolyses in the presence of acid. The acid hydrolysis first attacks the N—P bond. Dimethylamine hydrochloride and phosphoric acid are the ultimate hydrolysis products.

A *bis*(*bis*dimethylaminophosphonous)anhydride spray has a weak contact insecticidal effect, and a dry residual film on plants is, by contact, almost non-insecticidal No fumigation effect can be demonstrated either of the substance itself or of the treated foliage.

A systemic action can be demonstrated either by placing the leaves or twigs bearing feeding aphides in a solution of the chemical, or by spraying it on leaves to give only a partial cover. Table 1 shows how small a concentration will give, within a few days, 100 per cent kill of cabbage aphis.

Table 1. Effect of feeding *Brevicoryne brassicæ* on brussels sprouts leaves standing in solutions of *bis*(*bis*dimethylaminophosphonous)-anhydride

Concentration (per cent)	Time to give 100 per cent kill
0·5	16 hours
0·1	28
0·05	40
0·016	72
0·009	72
0·0047	96
0·0024	96

On growing plants, it was possible to spray four out of every five leaves on the plant and so protect the fifth leaf as to avoid all possibility of drift. On the unsprayed leaf, the complete kill of the aphis demonstrated the systemic action. Systemic action can also be demonstrated by painting a strip on a leaf with the chemical (leaving the remainder unsprayed) and then observing within eight days a complete kill of all the aphides feeding on the leaf. This systemic action has been demonstrated on a number of important crop plants.

The insects named in Table 2 have been found to be killed by systemic action by *bis*(*bis*dimethylaminophosphonous)anhydride; the nomenclature is that of Kloet and Hincks[5].

Table 2

Family	Species	Host plant
Typhlocybidæ	*Typhlocyba* spp.	potato, apple
	Empoasca lybica	cotton
Aleyrodidæ	*Aleyrodes proletella* Linn.	cabbage
Aphididæ	*Macrosiphum euphorbiæ* Thomas	beet, potato
	Macrosiphoniella sanborni Gillette	chrysanthemum
	**Phorodon pruni* Scop.	hops
	**Myzus persicæ* Sulz.	beet, cabbage, potato
	Aulacorthum circumflexum Buckt.	beet, cineraria, chrysanthemum, hydrangea
	**Brevicoryne brassicæ* Linn.	cabbage, charlock, mustard
	Doralis fabæ Scop.	beet, beans
	D. pomi Degeer	apple
	Yezabura malifoliæ Fitch	apple
	Brachycaudus cardui Linn.	cineraria
	Eriosoma lanigerum Hausm.	apple
Coccidæ	*Pseudococcus citri* Risso	various plants
Tetranychid mites	*Tetranychus telarius*	carnation
	T. bimaculatus Harvey	apple, pear
	Oligonychus ulmi Koch	apple
	Bryobia praticea Koch	apple, pear

All these species have been tested under normal growing conditions, and those marked with an asterisk have also been treated on a normal commercial spraying scale. There is already evidence of great differences between the lethal dose required for various species of aphis.

Against other groups of insects the results summarized in Table 3 were obtained.

Table 3

Coleoptera	
Calandra granaria	No residual contact effect on leaves
Meligethes æneus	No residual toxic effect on leaves
Coccinella septempunctata	No residual toxic effect on leaves. In field-trials no dead adults or larvæ were ever noted, and there appeared to be no diminution in numbers until the aphis population was consumed. Moribund aphides from sprayed plants were shown to be non-toxic to adult coccinellids
Adalia bipunctata	Similar observations to *C. septempunctata*
Diptera	
Syrphus sp. (larva)	Not usually killed by spray in field-trials
	No quantitative observations
Lucilia sericata	No residual contact toxicity
Hymenoptera	
Apis mellifera	No residual contact toxicity
Aphidius sp.	Pupæ survive 5 per cent spray. No apparent toxicity to adults.
Lepidoptera	
Pieris brassicæ	Larvæ unaffected when feeding on plants which are toxic to aphides

The results show that *bis*(*bis*dimethylaminophosphonous)anhydride is systemic in action, is specially effective against aphides and certain related Homoptera, and is selective, in that it is relatively non-toxic to beneficial insects.

Field experiments on brussels sprouts infested with cabbage aphis showed an initial kill of 72 per cent with an application of 3 lb. *bis*(*bis*dimethylaminophosphonous)anhydride per acre in 150 gallons water (0·2 per cent). After fourteen days, a 70 per cent reduction was still maintained.

In another trial this degree of control was maintained for seven weeks, and only at the eighth week did the infestation begin to increase slightly. The maximum kill at this concentration is attained about ten days after spraying. A similar spray was also successful against *Brevicoryne brassicæ* on a cabbage seed crop. A good control in the field was also obtained against aphis on hops, where dosages as low as 1½ and 3 lb. per acre gave 100 per cent control. The effect lasted in this case for more than six weeks, since the plants remained toxic during the 3–4-week migration period. Good aphis control was also obtained with 'Parathion' (diethyl*para*nitrophenyl thiophosphate) and hexaethyl tetraphosphate, but during the flight period of the aphis these latter plots became re-infested and three applications of spray were needed during the season. Plants sprayed with *bis*(*bis*dimethylaminophosphonous)anhydride were more vigorous and yielded better.

Effect on Plants

The effectiveness of a systemic insecticide will obviously depend very largely upon its behaviour in the plant. It is known that *bis*(*bis*dimethylaminophosphonous)anhydride can enter the plant through the stomata, the cuticle of the leaves, the roots and

the cut stems, and the chemical then travels within the plant, where it seems to be translocated to growing parts. The rate of movement and distribution in the plant is now being studied by the use of radio tracers and other methods. It would be premature to draw any conclusions other than that this systemic insecticide is effective on young plants but not on plants which are mature and have stopped growing. Some plants tolerate the chemical well; others do not.

Plants which tolerate the chemical include brussels sprouts, which are not damaged by a solution of up to 20 per cent, sugar beet, in which no damage has been observed, and hops, on which this chemical seems to have a beneficial effect. Peas show very slight necrotic spot when sprayed at a rate greater than 3 lb. per acre, but not when sprayed at 1½ lb. per acre. Potatoes are susceptible under certain conditions (particularly King Edward), and scorch was also produced on beans (*Vicia*). Apples, on the other hand, showed no sign of scorch, although the varieties Cox's orange pippin and Worcester permain suffered fruit drop and defoliation. The use of the chemical is therefore only contemplated at present on peas, brussels sprouts, sugar beet and hops.

Effects on Mammals

Because of the considerable toxic hazards which are experienced with hexaethyltetraphosphate and 'Parathion', it was necessary to carry out a very careful examination of the human and mammalian toxicity of *bis*(*bis*dimethylaminophosphonous)anhydride. Extensive trials on mice, rabbits, guinea pigs and rats have been carried out, not only by injection and feeding with the toxic compound, but also by rearing animals for months on food harvested from sprayed plots.

The results to date can be summarized as follows. It was found that, by oral administration, a higher toxicity was obtained when the chemical was mixed with dry foods than when it was injected into plants, and that the minimum lethal dose, when mixed with dry foods, is: rats, 22 mgm. per kilo; guinea pigs, 35 mgm. per kilo; and rabbits, 60 mgm. per kilo. For skin absorption, the minimum lethal dosage for rats seems to be 200 mgm. per kilo, compared with 63 mgm. per kilo for 'Parathion'. These figures should be regarded as a preliminary indication, pending the completion of more elaborate experiments now in progress.

Trials have also been carried out on feeding animals with plant materials which have been previously sprayed, and Table 4 gives a summary of some of the results. In no case were any toxic symptoms observed.

Table 4

Crop	Dose (lb. per acre)	Quantity of crop consumed per animal (in lb.)	Period between spraying and feeding
Sugar beet	15	12½	10 weeks
Brussels sprouts	1½	20	10 days
Brussels sprouts	3	20	10 ,,
Pea plants	1	16	30 ,,
Pea plants	2	16	30 ,,
Pea pods and peas	1	6½	60 ,,
Pea pods and peas	2	6½	60 ,,

The toxicity of the concentrated spray chemical calls for adequate protection to spray operators, to prevent any skin contact; but results to date indicate that there is no hazard for the consumer of sprayed plant material provided a period of at least two months elapses between the last spraying and the harvesting.

Practical Applications

Mention was made earlier of the possibility of controlling virus diseases through their vectors, for which purpose a persistent translocated insecticide would appear to be ideal. In 1948, *bis*(*bis*dimethylaminophosphonous)anhydride was tried for the prevention of yellows virus on sugar beet. Some tests failed owing to lack of information, at that time, on the conditions necessary for absorption by the plants, but several gave some reduction in virus at the end of the season. In the best trial, sprayed once only, the virus infection at the end of the season was 64 per cent of the plants on unsprayed plots against 18 per cent on the sprayed. The difference in appearance of the sprayed and unsprayed beet was remarkable, and the result encourages the hope that more extensive trials in 1949 will establish the possibility of virus prevention.

While a great deal of work on *bis*(*bis*dimethylaminophosphonous)anhydride remains to be done, sufficient progress has been made to establish that it is an effective systemic and selective insecticide.

Whatever may be its application to agriculture, it represents an important step forward in applied entomology, in that it is the first insecticide which combines systemic and selective properties. It should have many advantages. Its systemic properties enable it to reach insects which it would be extremely difficult to kill by direct contact effect, and its persistence enables it to be used early in the development of an aphis outbreak without fear of re-infestation. This will also considerably cheapen the control of many species. Its selective properties are valuable in making use of biological control to supplement spraying, and also by this means preventing the survival of resistant individuals to build up resistant strains.

[1] Ripper, W. E., *Nature*, **153**, 448 (1944).
[2] Volterra, V., *J. Conseil intern. pour l'Exploration de la Mer*, **3**, 1 (1928).
[3] Schrader, G., in Brit. Intell. Obj. Subcomm., Final Report 1095.
[4] Bennett, S. H., and Martin, H., Ann. Rep. Agric. and Hort. Res. Sta. Long Ashton for 1947, pp. 147–156.
[5] Kloet, G. S., and Hincks, W. D., "A Check List of British Insects" (1945).

COMMITTEE ON INDUSTRIAL PRODUCTIVITY

THE first report of the Committee on Industrial Productivity* covers the activities of the Committee from its first meeting on February 4, 1948, up to the end of that year. Besides the directive of the Lord President of the Council and the Chancellor of the Exchequer to study the short-term rather than the long-term problems, and to consider methods of increasing productivity which do not require large capital expenditure, the Committee has been guided in its choice of problems by a statement from the Economic Planning Board as to the industries most likely to yield valuable results within a short period. These included essential industries under-manned in relation to supplies of material and productive

* First Report of Committee on Industrial Productivity. (Command Papers.) (London: H.M. Stationery Office, 1949.) 6d. net.

capacity; industries with a comparatively low productivity compared with pre-war practice or with more considerable variations in efficiency than could be explained by the degree or quality of capital equipment; industries producing items of key importance, where even the complete manning of present capacity would not provide sufficient supplies to meet the demand; and industries, or sections of industries, where high costs of production, which could be reduced by increased productivity, were likely to affect export sales.

The Committee welcomes many existing activities such as those of the Manchester Joint Research Council, the Anglo-American Council on Productivity, the British Institute of Management, the Scottish Council (Development and Industry), and certain activities in this field of the research associations, all of which tend to increase collaboration and the transfer of scientific knowledge from the laboratory to the factory. It does not, however, go into the means of transmitting such knowledge, and it accepts the view that the establishment of the National Research and Development Corporation and of development councils for particular industries will provide all that is required. Its most positive recommendation is for full support to the development of a system for regular collection and publication of reliable data on productivity.

Although there are few constructive suggestions and many unexceptionable platitudes in the report, the Committee indicates a number of weaknesses which require attention. The section of the report dealing with the work of the Panel on Technology and Operational Research follows the Working Party for the Cotton Industry in pointing to the deficiencies in development and research in textile machinery, and has already arranged for a preliminary survey of the research and development facilities available in the textile machinery industry (apart from dyeing and finishing) and a review of promising new developments in textile machines. So far as the cotton textile industry is concerned, the Panel concluded that the first need was for a concerted effort to apply the principles of good organisation and deployment of labour over an increasing range of firms, both in the spinning and weaving sections of the industry. The Panel believes that such measures could substantially increase productivity without the need for a larger labour force, longer hours of work, or large capital investment.

The Panel regards a large part of the foundry industry as capable of improvement in technical equipment, lay-out and general working conditions, and also agrees that an expansion of the scientific instrument industry to a size fully adequate to cater for the needs of British industry is necessary. The possibility of improving productivity through the more general use of automatic control systems has also been studied. In accordance with one of its main terms of reference, the Panel has made, through a 'working party', a comprehensive study of the principles and practice of operational research both as applied in the Services during the War and in its possible applications in the industrial field. Stress here is laid on the maintenance of a close link between the research worker and the responsible executive, and the Panel believes there is still room for a considerable extension of this method.

The Panel on Imports Substitution has maintained close contact with the Colonial Primary Products Committee. Accepting the view that it is technically feasible to increase the production of food in Great Britain by as much as twenty per cent in five years, the Panel stresses the importance of intensifying the Ministry of Agricultur.'a grassland policy, and believes that it should be possible to increase the total yield of grassland by twenty per cent in the next four years. This yield would provide enough feeding stuffs for cattle to permit a saving on imports of more than £40 million per annum at present prices, and would enable available supplies of imported feed to be used mainly for pigs and poultry. While, however, the Panel recognizes that such an achievement would demand great efforts from the agricultural community, it does not mention the other implications, or even what is involved in the deployment of labour. Its recommendations for expansion of the capacity for production in Britain of nitrogenous fertilizer seem equally divorced from any consideration of the real shape of British economy, while under pest control the single recommendation relating to the extermination of rabbits ignores entirely any consideration that wild rabbits, although consuming seven million tons a year of herbage, may provide agricultural workers with a staple alternative to an attenuated meat ration.

Other recommendations from this Panel include the increased use of esparto grass for paper-making to the limit of capacity of the esparto-pulp mills, and the erection of new pulp mills to utilize indigenous surplus straw; the substitution of cold-formed strip or high-tensile steel for hot-rolled steel; the increased use of reinforced, and particularly of prestressed, concrete in place of steel; and the increased use of pyrites, anhydrite and spent oxide for the manufacture of sulphuric acid.

The Panel on Human Relations appointed a research advisory group, including representatives of the Medical Research Council, the British Institute of Management, institutions engaged in research in the social sciences and certain university departments of psychology and social science, to survey the field. A report received from this Group in March 1948 emphasized the need for investigators with practical experience, and the absence of readily available facilities for supplementing academic instruction with practical experience. The Group also recommended a list of projects which could be undertaken by institutions represented on the Group, and which at the same time would provide practical training for recruited workers. On the basis of this report, the Panel recommends the undertaking of five different types of investigation. In the first type, that of extensive surveys of managerial practice, the National Institute of Industrial Psychology is undertaking studies of the status, selection and training of foremen and of methods of joint selection. In the field of 'human engineering', the Applied Psychology Unit of the Medical Research Council is investigating factors influencing machine tool and work design at the Psychological Laboratory at Cambridge, where the Nuffield Research Unit is also investigating the effects of ageing with special reference to their bearing on industrial productivity, and the National Institute of Industrial Psychology is to investigate the optimum unit of work. In the third type, that of comparative case studies, two teams belonging to the Industrial Psychology Unit of the Medical Research Council have made general studies of satisfaction and dissatisfaction with work in two motor manufacturing companies in which there are clear differences in

managerial practice, in three royal ordnance factories where rates of productivity in the output of similar products differ significantly, and are making comparative studies of units in the Metals Division of Imperial Chemical Industries, Ltd.

The fourth type, that of the intensive study of human relations within a particular firm, is represented by the Tavistock Institute's project at the Glacier Metal Co.; while the fifth type, namely, project-investigation of methods for communicating ideas and information, is represented by the experimental use of group discussion method in training supervisors, particularly in the human relations aspects of their work, the use of this method to improve inter-group communication in a firm as a means of dealing with a problem of 'quality control', and an evaluation of a 'training within industry' programme in a section of a firm. Besides these projects, the Panel is also interested in a series initiated by the British Institute of Management and the Medical Research Council, and has discussed with the Occupational Medicine Committee of the latter the problem of collecting and interpreting statistical records designed to throw light on the influence of health on productivity, particularly the incidence and relative importance of different types of illness and injury. The Panel is also studying the effects of compulsory national service on the training and attitude to work of the young industrial worker.

The Panel on Technical Information Services, under the chairmanship of Dr. A. King, continues the work of a committee previously set up under the Advisory Council on Scientific Policy. Attention has first been given to the organisation of such services in Government departments, and the Panel recommends that the Intelligence Division at the headquarters of the Department of Scientific and Industrial Research should be regarded as the focal point to which general requests for technical information from any Government source should be directed, and that its staff should be strengthened as required for this purpose. The Panel has initiated a general inquiry into the services provided by the chief scientific and technical libraries of Britain, and is working in close collaboration with the standing committee set up by the Royal Society to implement the recommendations of the Commonwealth Conference on Scientific Information, particularly those relating to technical libraries, mechanical aids for indexing and selection and an index of research activities.

THE CENTENARY OF BEDFORD COLLEGE FOR WOMEN

QUEEN VICTORIA had been only twelve years on the throne when there was inaugurated in Bedford Square, London, a "Ladies' College" at which young women might acquire something more than their customary, somewhat vacuous, social background. Its founder, Mrs. Reid, had dreamed for many years of such a college for women, and it was owing to her ceaseless effort and zeal that Bedford College opened its doors a full twenty years before Girton College was opened at Hitchin or the idea of Newnham College was conceived.

Mrs. Reid, though far ahead of her time in visualizing her college as a seat of moral culture, would have been overwhelmingly proud, and perhaps not a little surprised, could she see the place it holds in the educational world in its centenary year.

Bedford College owes much to other early pioneers of women's emancipation; such names as Elizabeth Bostock, Eleanor Smith, Jane Martineau, Henrietta Busk and William Shaen, to mention a few, are familiar to all who delve into its past, and many are remembered in more tangible form in connexion with some generous gift or bequest.

The serious obstacle to the accomplishment of Mrs. Reid's dream was that the lack of educational background of the girls of her day made them totally unqualified to benefit by the standard of learning aimed at. By the time the College moved to 8 and 9, York Place, Baker Street, more and better girls' schools existed, so that when in 1878 the University of London opened its examinations to women, the students from Bedford College were among the first candidates. In 1881 the College recorded its first three graduates in arts, all placed in the first division, and followed the next year by the first B.Sc.; the first M.A. came in 1886. Small beginnings: but what a wealth of initiative, enthusiasm, perseverance and toil had gone into their attainment.

Science, by the very nature of its needs, developed slowly; accommodation and facilities for practical work were at first negligible, the only two laboratories being in the basement kitchens, until in 1889 new laboratories were designed in the rear of York Place.

In 1894 grants from the Government and the London County Council enabled the College to raise its teachers' stipends, lower the students' fees and proceed to increased prosperity less trammelled by financial worries and better directed in its academic life. After 1895 a few departments carried readerships or professorships according to the newly introduced University of London scheme; but it was not until 1929 that the College gained direct representation on the Senate.

With the removal of the College in 1913 to its present home in Regent's Park, a wide expansion occurred; the number of students rose to more than four hundred—Bedford College had become a centre of learning worthy not only in its teaching, but also in the facilities it provided in its dignified buildings with its halls of residence, departmental lecture rooms, well-equipped laboratories, spacious common rooms and fine library set in eight acres of beautiful grounds. Much of this had come about by public appeal and generous benefactions, foremost among the latter being the magnificent gift of £105,000 for endowment purposes by Sir Hildred Carlile in memory of his mother.

So began another era in the history of the College; but this was unfortunately interrupted by the First World War. After the War, the demand for higher education by women became so great that this, the largest of the women's colleges, was hard put to it to accommodate its students. In 1930 a new building completed the College quadrangle, commemorating in its name Dame Margaret Tuke, principal for twenty-two years, who retired the year before its official opening in 1931.

Once more there was a period of grace and expansion during which several new professorships and readerships were established. The College numbered about six hundred and fifty students and fostered a vigorous intellectual and social life through the thriving students' societies and intercollegiate activities.

With the outbreak of the Second World War came an upheaval, both bodily and spiritually. Bedford College was evacuated to Cambridge, and though its students and staff appreciated their association with the ancient University, the strain on the staff was considerable in the crowded conditions, the disembodied state of the College and the hectic atmosphere of war. The wisdom of this evacuation was justified when the main building (occupied at the time by the B.B.C.), one science block and the dining hall were destroyed by enemy action in the great fire raid of May 10, 1941.

In 1944 the College returned to London. Readjustments had to be made, as about a third of the buildings had been demolished and many more women were clamouring for a university education. To ease the accommodation of its now 830 students, three of the stately houses in Regent's Park have been acquired.

To-day, the signs of devastation are receding and progress in rebuilding is at last apparent; the dining hall and new mathematics department over it have been in use since October 1948, and though the north science block will be rebuilt later, the main building, it is hoped, will open its doors in 1951.

In the hundred years of its life, 15,000 students have entered the College, two-fifths of these in the last twenty-five years. The majority, particularly of the arts graduates, have entered the teaching profession, and not only are there many principals of training colleges and headmistresses in Great Britain, but also in other parts of the world, including Australia, New Zealand, India, Ceylon, South Africa, West Africa, Nigeria, Tanganyika, Jamaica, Malaya, China and Japan.

It was in its Victorian era that Bedford began to provide leaders in education in the two vice-principals and later a principal of Newnham College, a vice-principal of Somerville College and the founder and first headmistress of Roedean School. From this period, too, came Miss Phillipa Fawcett, who, having been placed above the Senior Wrangler, afterwards served in the Transvaal Education Department and returned later to serve for thirty years as assistant to the Education Officer of the London Councy Council. The first woman barrister was a student of the College in 1857, and in 1880 another graduate became an alderman of the London County Council. Incidentally, the first woman to be made a professor of the University of London was a member of the College staff, and it is to be recorded with pride that the first woman vice-chancellor of a university within the Commonwealth, the present vice-chancellor of the University of London, is one of Bedford's professors. The science graduates are largely engaged in teaching or research. One of the professors of the University of London is a Bedford graduate, and another is professor of chemistry in a Government college in South Africa. Many are university readers, lecturers and demonstrators, and one of the first two women to be elected as Fellows of the Royal Society was a Bedford graduate. Interesting, too, is the fact that at the present time more than one-third of the women members of one of the learned societies of Great Britain graduated from the College.

Many past students have turned to librarianship and have become chief librarians of university colleges and also of public and other libraries. The College has sent out many pioneers connected with health and social services, providing one of the first women inspectors under the National Health Act (1913) and the first woman factory inspector in Sweden. To-day large numbers are engaged in social welfare. Bedford has also provided a pioneer in women's employment who, during a distinguished Civil Service career, became director of women's employment, H.M. Treasury. Many past students have played their part in other spheres, in journalism, on the stage and as authors, including at least one well-known novelist.

It is to women's education that the College has, perhaps, made its greatest contribution, not only through the representatives in the teaching profession already mentioned, but in the direction of educational films and educational programmes of the B.B.C.

Many have given much to Bedford College and she is deeply sensible of the debt. With the blessing of her patron, H.M. Queen Mary, on her centenary, she stands to-day a proud College of the University of London—the oldest women's university college in the world.

OBITUARIES

Dr. Melville Hocken

Dr. Melville Hocken told me, at his hospitable dinner-table in 1946, that he was born at Cardiff on January 10, 1888, when his parents were cruising off the Welsh coast—not in Cornwall, as has been stated elsewhere. He lived with his father, a Thames pilot, at Gravesend from the age of four to sixteen, during which years he discovered mole crickets in Kent and evinced an innate bent for biology, fostered by Moseley's 1892 *Challenger* voyage, received as a school prize in 1903. His first medical appointment was at the East Suffolk and Ipswich Hospital. In 1914 he joined the R.A.M.C. as senior medical officer at the Martlesham Experimental Station near Ipswich, and later served at Filby on the Norfolk Broads. In 1920, after a short time in Ipswich (like Thomas Muffet in 1585), he moved to the little Suffolk town of Halesworth, where he later bought Adams's commodious brewery house, with its excellent Charles I staircase of appliqué work. Practice so thrived that in 1938 he took two partners; and always another and very true one was his wife, Miss Winifred Triniman, a Cornish farmer's daughter.

For many years, leisure for purely biological study was lacking: Hocken had his way to make in the world. But the urge was innate, if not inherent. He had studied the British Tortricid moths to some extent before the First World War, and in 1935 his interest in them revived. In 1941 I pointed out the need for investigating the British Tipulidæ (crane-flies); he promptly joined the Entomological Society of London, secured its publications upon the subject and set himself, with characteristic ardour though already feeling bronchial trouble, to work out the local species. After four years assiduous study in every spare moment, and assistance from other members of the Suffolk Naturalists' Society, which he and Mrs. Hocken had joined in 1936, he published in its annual *Transactions* (pp. 184–98; 1945) a detailed résumé of the county's 151 known species, out of the 284 that occur in Britain; this was no mean achievement in so short a period. For the rest, he was possessed of a sound general knowledge of both flora and fauna.

In October 1946 Hocken was compelled by growing ill-health to retire from practice, and he went to his ever beloved "West Countrie"; and he died there, at St. Austell, on April 16. Claude Morley

Mr. C. H. Robinson

CLIFFORD HANKS ROBINSON, Dominion agricultural chemist in the Science Service, Department of Agriculture, Ottawa, died at the Civic Hospital there on April 11, at the age of sixty-two. He had been in poor health for some months and suffered a stroke on February 22 from which he did not recover.

Mr. Robinson was born in Lambton County, Ontario, and, having entered the University of Toronto in 1905, where he became an ardent disciple of the late Prof. Lash Miller, he graduated in 1909 with first-class honours in chemistry. Following a year of postgraduate work in organic chemistry, he accepted a position as assistant chemist in the Division of Chemistry at the Central Experimental Farm, Ottawa, and in 1914 became chief assistant to Dr. F. T. Shutt, Dominion chemist. On the retirement of Dr. Shutt in 1933, he was appointed acting Dominion agricultural chemist and was confirmed in that position in 1935.

Gifted with a keen and thoroughly practical mind, Mr. Robinson was well fitted to apply his wide knowledge of chemistry to the solution of agricultural problems, and he was a leading authority on agricultural chemistry in Canada. Under his direction the activities of the Division of Chemistry expanded rapidly, until at the present time they include research in animal nutrition, plant chemistry, food chemistry, soils and fertilizers, pesticides, vitamins and animal physiology, carried out at the central laboratories at Ottawa and in branch laboratories at Kentville, Nova Scotia, Summerland and Saanichton, British Columbia. Mr. Robinson served as departmental representative on several agricultural committees. He was a fellow of the Chemical Institute of Canada, and a member of many other societies connected with chemistry.

Mr. Robinson took a keen interest in sports of all kinds and in his younger days was an enthusiastic tennis and lacrosse player. In recent years, his prime interest was in his home, and he is survived by his wife, two sons and two daughters. His loss will be keenly felt not only by his family, but also by his host of personal friends and scientific associates in Ottawa and across Canada.

NEWS and VIEWS

Royal Society: Election of Foreign Members

AT a meeting of the Royal Society held on May 12 the following were elected foreign members of the Society: Prof. P. W. Bridgman, research professor of physics at Harvard University; Prof. N. L. Bowen, petrologist at the Geophysical Laboratory, Carnegie Institution, Washington; Prof. Max von Laue, of the Max Planck Institute, Göttingen, Germany; Prof. Erwin Schrödinger, senior professor and director of the Department of Theoretical Physics, Dublin Institute of Advanced Studies, Dublin.

Prof. N. L. Bowen

DR. N. L. BOWEN, of the Geophysical Laboratory of the Carnegie Institution, Washington, and sometime distinguished service professor of petrology in the University of Chicago, is one of the great pioneers in quantitative experimental petrology. Distinguished as physical chemist and petrologist, an experimenter of the first rank, his researches have been primarily devoted to the experimental field of silicate equilibria at high temperatures, and to the application of these and related studies to the fundamental problems of the igneous rocks. Some of his great contributions to petrogenesis—on the role of fractional crystallization in the evolution of igneous magma, the concept of the reaction series in the igneous melt and his critical assessment of magmatic assimilation processes—have been brilliantly developed in his "Evolution of the Igneous Rocks" (1928), a survey and synthesis which has exerted a greater influence on petrological thought than any other contribution in this field over many years. These, with his later studies, have made a deep impression in an ever widening field, not only in igneous and metamorphic petrology but also in the related study of silicate technology.

Dr. Bowen's work has not been confined to the laboratory. He gained his early field training with the Geological Survey of Canada, and ever since going to the Geophysical Laboratory of the Carnegie Institution in 1912 his experimental work has been happily blended with research in the field. Some of the outstanding products of this dual study so fruitfully conceived are exemplified in his investigations on the ultrabasic rocks, notably the peridotites of the Cuillin Hills of Skye, and in his work in the volcanic fields of East Africa. In the history of experimental research in petrology, particularly the study of heterogeneous equilibria in silicate melts, no one has broken so much new ground or contributed in richer measure to the solution of fundamental problems of igneous petrogenesis.

Prof. P. W. Bridgman

PROF. P. W. BRIDGMAN, research professor of physics at Harvard University, is known to all physicists for his pioneering work on the properties of substances at very high pressures. Bridgman devised new methods to withstand high pressures, particularly the method of the unsupported area which enables joints to be designed which become tighter the higher the pressure. In the first stage of his work he studied the properties of substances up to pressures of 20,000 atmospheres: the change of volume, the melting and transition points, the viscosity and the electrical properties. As a result of his researches on the behaviour of materials under pressure, he was next able to extend his measurements to pressures of 50,000 atmospheres, and further apparatus is being developed in his laboratory for investigations to pressures of 100,000 atmospheres. Not only is the work of direct application to geophysics and other branches of science and technology, but also the investigation of the effect of pressure on the outer structure of atoms is of theoretical importance. Bridgman was awarded the Nobel Prize for Physics in 1946. He is not only a pioneer in this field of high pressure, but also has made important contributions to thermodynamical and statistical theory and has also influenced philosophical thought in the realm of mathematical logic.

Prof. Max von Laue

THE election of Max von Laue to foreign membership of the Royal Society will give the greatest pleasure to his many friends in Great Britain and abroad. It is a fitting recognition of his life-time of scientific work, and in particular of his discovery of the diffraction of X-rays by a crystal lattice. In the year 1912 Laue made the suggestion that if X-rays were in reality electromagnetic waves like light, the regularly spaced arrangement of atoms in a crystal might be expected to provide a grating of suitable scale to yield diffraction effects. The crucial experiment was carried out by two young research workers in the Physics Laboratory at the University of Munich, and its result was the first 'Laue photograph'. Two new branches of science have been founded on this original experiment. X-ray spectroscopy has played an important part in all investigations into the structure of the atom. Crystal analysis has led to an immense advance in our knowledge of the structure of matter of all kinds, and has profoundly modified many of our views in physics, chemistry, metallurgy and mineralogy. It may soon be possible to add biochemistry to this list. This deserved recognition of Laue's great scientific work will be universally welcomed; but to his personal friends it will afford an even deeper pleasure because of their affection for a brave, courteous and kindly man. The reception accorded to Laue when he was a guest at the meeting of the X-ray Analysis Group of the Institute of Physics soon after the end of the War was an index of the regard in which he is held by all who know him. It is hard to think of an election which could give more general satisfaction.

Prof. E. Schrödinger

ERWIN SCHRÖDINGER, born at Vienna in 1887, comes from that distinguished Austrian school of physics of which Stefan, Loschmidt, Mach and Boltzmann were the most notable representatives. He began his academic career in 1914 as *Privat-Dozent* at the University of Vienna. Since 1920 he has occupied chairs of theoretical physics in Stuttgart, Breslau, Zurich and Berlin, where he was the successor of Max Planck. After Hitler's access to power in 1933, he left Germany of his own free will and went to Oxford. After a short interlude in Graz, which ended with the "Anschluss", he went to Dublin to become a member, and for a time director, of the newly founded Institute for Advanced Studies. Schrödinger's first publications cover a wide field, for example, vibrations and specific heat of crystals, quantum mechanics of spectra, and so on. Most remarkable are his investigations in the mathematical structure of the physiological colour-space. His international fame, however, is based on his wave mechanics of 1926. The series of papers, in which he developed an ingenious idea of de Broglie's to a complete theory of atomic structures, and demonstrated, moreover, the relation of his wave equation to other forms of quantum mechanics (Heisenberg – Born – Jordan, Dirac), belong to the classics of theoretical physics by virtue of their depth, wealth, completeness and brilliant style. In recent years, Schrödinger has made great efforts to unify the different field theories of physics into a coherent system. He has further published several little books, one of which was a condensed presentation of statistical thermodynamics; another, with the daring title "What is Life?", being an expansion of the modern theory of heredity from the point of view of the physicist. Although Schrödinger has never had a school of his own, he has influenced physics immensely. There is scarcely a paper on atomic theory which does not refer to his name in connexion with his wave equation.

Memorials to Dr. T. N. Annandale

ON April 10 some past and present members of the Zoological Survey of India assembled at the Scottish Cemetery, Calcutta, to pay homage to the memory of Dr. Thomas Nelson Annandale, the founder-director of the Survey, who died on April 10, 1924, twenty-five years ago. The Royal Asiatic Society of Bengal, with which he was closely associated throughout his period of service in India as anthropological secretary, vice-president, and as its president in 1923, perpetuates his memory by a triennial award of the Annandale Memorial Medal to a person who has made the most important contribution, during the previous five years, to anthropology in Asia, and the first award was made to Dr. Fritz Sarasin in 1928. Thereafter the award has been made alternately for physical and cultural anthropology. The Society has a sepia portrait and an oil painting of Annandale. The Council of the Society is now appealing for funds to perpetuate the memory of Annandale. It is suggested that the balance of income of the Annandale Memorial Fund be suitably invested until the accumulated amount is sufficient, after paying for the triennial award, to provide Rs. 250 a year, to be utilized for a biennial anthropological lectureship. Annandale had been the last superintendent of the Indian Museum, and this office he held during 1907–16. He succeeded Colonel Alcock, and relinquished the office on becoming the first director of the Zoological Survey of India. The Trustees of the Indian Museum have also perpetuated his memory by putting up a brass tablet in the premises.

Radioactive Substances Advisory Committee

THE Minister of Health, the Secretary of State for Scotland, the Minister of Supply, and the Minister of Health and Local Government for Northern Ireland, have appointed a Radioactive Substances Advisory Committee to advise on measures to safeguard workpeople and the public generally against the danger of exposure to radiation from radioactive substances and certain irradiating apparatus. The Committee consists of Sir Henry Dale (chairman); Dr. J. P. Baxter, Imperial Chemical Industries, Ltd., Research Department, Widnes Laboratory, Lancs; Mr. W. Binks, National Physical Laboratory; Sir Ernest Rock Carling; Mr. D. G. Catcheside, Botany School, Cambridge; Lord Cherwell, Clarendon Laboratory, Oxford; Sir John Cockcroft, Atomic Energy Research Establishment, Harwell, Berks; Prof. N. Feather, Department of Natural Philosophy, University of Edinburgh; Dr. L. H. Gray, M.R.C. Radiotherapeutic Research Unit, Hammersmith Hospital, London, W.12; Capt. Mark Hewitson, M.P., National Union of General and Municipal Workers, 5 Endsleigh Gardens, London, W.C.1; Dr. J. F. Loutit, Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell; Prof. W. V. Mayneord, Royal Cancer Hospital, London, S.W.3; Prof. R. McWhirter, Radiology Department, Royal Infirmary, Edinburgh 3; Dr. E. R. A. Mereweather, H.M. Senior Inspector of Factories, Ministry of Labour and National Service, London, S.W.1; Dr. Ralston

Paterson, Holt Radium Institute, Wilmslow Road, Withington, Manchester; Mr. H. S. Souttar; Sir George Thomson, Imperial College of Science and Technology, London, S.W.7; Prof. B. W. Windeyer, Meyerstein Institute of Radiotherapy, Middlesex Hospital, London, W.1.

Research in Industry

UNDER the title "Research in Industry" the Department of Scientific and Industrial Research and the Board of Trade have issued a reprint of nineteen articles published in the *Board of Trade Journal* between May 1947 and March 1948. This pamphlet of 84 pages is published by H.M. Stationery Office and costs 1*s.* 6*d.* The articles are written to illustrate factually the contention that the use of science in industry is essential for the survival of Great Britain. There are contributions by the directors or other officers of the research associations, indicating the part those associations are taking in the progress of the cotton, wool, iron and steel, rayon, pottery, linen, boot and shoe, paint, furniture, electrical and consumer-goods industries; and these articles are supported by others on electronics as an aid to production, the glass industry, the lace industry, the plastics industry, machine tool and small tool research for the engineering industry, the light-engineering industry, and industrial design research, and by a contribution from Sir Robert Watson-Watt on the industrial application of radar in peace-time. Sir Edward Appleton has written a general introduction on how science can help industry, in which he once again emphasizes the importance of securing the widest possible dissemination of knowledge of the results of research and its utilization in Great Britain. While the articles are admirable as an introduction, they are no substitute for the individual reports of the research boards, stations or research associations, still less of the Department of Scientific and Industrial Research as a whole, the pre-war annual report of which was an important document for knowledge of scientific and technical progress.

Fundamental Education

IN 1947 the United States National Commission for Unesco constituted a Panel on Fundamental Education to consider how the proposals set out in the Unesco book, "Fundamental Education—Common Ground for all Peoples", could be applied in the United States. The panel meets under the chairmanship of Mr. John W. Studebaker, the Commissioner for Education, and is composed of specialists in many fields concerned with fundamental education who are broadly representative of various public and private agencies and associations throughout the country. Its first bulletin, called "Fundamental Education", has now been issued and provides important technical information both on the way in which the Unesco Secretariat may carry out the international project and also on the way the development of fundamental education in the United States may be encouraged. Copies of the bulletin may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington.

New Zealand Earthquakes during 1946

ACCORDING to the *Dominion Observatory Bulletin*, No. S–85, there were recorded in New Zealand, during 1946, 273 locally felt earthquakes. One of these, on June 26, was felt with Modified Mercalli scale 7–8, while five others, on February 12, February 26, June 7, June 28 and September 14, were felt with scale 6. The remainder had lesser intensities. The general distribution of earthquakes was such that most had epicentres north of the latitude of Christchurch with very few to the south of this line. There was a strong cluster of epicentres to the south-southwest of Arthur's Pass at the northern end of the Southern Alps, and the epicentre of the shock of June 26 was in this region. Another cluster lay in the Tasman Sea towards Cook Strait, while further epicentres tended to lie towards the median line of North Island between Wanganui and the Bay of Plenty, and others in the Pacific Ocean to the north-east of New Zealand. The second greatest shock, that on February 12 (scale 6+), had its epicentre at a point to the south-east of Wanganui at the southern end of North Island.

Palæozoic Arachnida

PROF. ALEXANDER PETRUNKEVITCH, a distinguished arachnologist, has furnished an account of the Palæozoic Arachnida in the *Transactions of the Connecticut Academy of Arts and Sciences*, vol. 37, 1949 (New Haven, Conn., pp. 257, 7.70 dollars). This is particularly interesting in Great Britain, since it is very largely based on the rich collection of material in the British Museum (Natural History). It is not simply a description of species, although 169 species are dealt with, but rather a review of their structure, classification and relationships. In order to carry out this work adequately, full cognizance is taken of the considerable advances made in recent years in our knowledge of the comparative anatomy and development of living forms. The description of the structure of both fossil and living Arachnida in general, the adequate definitions of the orders and the keys for their separation are useful not only to the palæontologist but also to the student of recent forms. The author concludes that at an early geological age the Arachnida split into a number of orders; but that all of them exhibit the same fundamental trends, including a shortening of the abdomen through a loss of posterior segments. There is also a tendency to simplification, exemplified, *inter alia*, by the loss of abdominal appendages save the combs in scorpions, and the spinnerets in spiders, and, further, in the former by a reduction of the number of teeth in the comb and in the latter by a reduction of the number of spinnerets from four pairs to one pair. The work concludes with an interesting and useful discussion of these and similar trends, not only in the class as a whole, but also in its various subdivisions, and consideration of the evolutionary and classification significance of such trends. The paper is provided with a full bibliography, well indexed, and illustrated by eighty-three plates, thirty of which are excellent photographic reproductions of the material.

Reactions of some Passerine Birds to a Stuffed Cuckoo

DURING the spring of 1948 George Edwards, Eric Hosking and Stuart Smith carried out experiments to test the reactions of certain of the smaller birds to the presence of a stuffed cuckoo and other animals in their nesting territories (*British Birds*, **42**, No. 1; January 1949). Experiments were of an exploratory nature, but enough evidence has been collected to show that certain birds appear able to determine one type of

dummy from another. Willow-warblers will attack a stuffed cuckoo but will not go near a stuffed sparrow-hawk. Nightingales will attack both hawk and cuckoo, but fear a stuffed stoat. Blackbirds disregard a cuckoo but attack a jay. Tree-pipits attack a cuckoo violently, but will not approach a jay; whin-chats attack both cuckoo and sparrow-hawk. The article contains a detailed account of these reactions as well as many excellent close-up photographs which were taken during the experiments.

Mushroom Diseases

A SMALL booklet has recently been compiled by Mr. Fred C. Atkins, entitled "Major Diseases of the Cultivated White Mushroom" (Yaxley, Peterborough: Midlands Group Publications, 1948; 2*s*. 6*d*.). It deals with bacterial pit, caused by *Pseudomonas* (?) *fluorescens*, bacterial blotch (*Phytomonas Tolaasi*), cobweb or mildew due to *Dactylium dendroides*, bubble (*Mycogone perniciosa*) and brown spot (*Verticillium* spp.). Most of the descriptions have appeared in the *Bulletin of the Mushroom Growers' Association*; but practical growers and others will welcome their collection into a booklet with photographs, drawings and succinct accounts of control. It is planned to issue further booklets on major competitors, and on minor diseases and competitors of the cultivated mushroom.

Unstability in the Rust Fungi

THE life-history of a rust fungus is usually regarded as sufficiently stable to have some diagnostic value. Recent knowledge shows, however, that there are exceptions. Malcolm Wilson (*Proc. Roy. Soc. Edin.*, B, 63, Part 2, No. 11, 177; 1948) reviews the literature dealing with instability, and describes four British cases where uredosori contained a proportion of teleutospores. All the unstable species now known belong to the Pucciniaceæ, a relatively advanced family of the rust fungi. The taxonomic position of their host species also agrees with their relatively advanced condition. The interesting theory that unstable species lead to the production of micro-*Puccinia* forms is now formulated, and seems to provide a useful insight into the phylogeny of these organisms. Special environmental conditions appear to induce instability of life-history, and this itself is another interesting feature.

Strains of Host and Virus

STRAINS of various virus diseases are now well recognized by research workers. B. Kassanis and Ireson W. Selman (*J. Pomol. Hort. Sci.*, 23, Nos. 3, 4; Dec., 1947) now demonstrate two strains in a host plant (White Burley tobacco), which are barely distinguishable morphologically, but react differently to virus infection. Tomato aucuba mosaic produces necrotic local lesions or systemic necrosis in one host strain, and a yellow mottle in the other. Some strains of tobacco mosaic also react necrotically in the first-mentioned host strain. This unsuspected selective action of the host may possibly explain discrepancies in etiology reported by various workers. The behaviour of various strains of potato virus *Y* has also been studied by F. C. Bawden and B. Kassanis (*Ann. Appl. Biol.*, 34, No. 4, 503–516; Dec. 1947). These various strains cause diseases in the variety Majestic, ranging in severity from mild mosaic to leaf-drop streak. Symptoms of the strains are also compared with the serologically related potato virus *C*, and possible mechanisms for the evolution of viruses *C* and *Y* are discussed.

Science and Society

THE Educational Centres Association is arranging a non-technical course for laymen and men of science who want an opportunity of studying the relations between science and society; it is to be held at Westham House, Barford, near Leamington, Warwickshire, during August 20–27. Inquiry will be made into the application of science to the raising of the standard of living and of bodily health; and in considering the reciprocal issues between science and society particular attention will be paid to recent developments in industrial and agricultural practice and to such topical questions as the atomic bomb and the Lysenko controversy. The course will be conducted by lectures and by seminar discussions, and during the latter students will concentrate either on chemical and physical considerations or on biology as applied to nutrition and disease. Further particulars can be obtained from the Education Secretary, Educational Centres Association, 8 Endsleigh Gardens, London, W.C.1.

Announcements

A CONFERENCE on "The Place of Agriculture in Education" will be held at Lord Wandsworth College, Long Sutton, near Basingstoke, Hants, on July 20. The conference will be opened by the Minister of Agriculture. Further information may be obtained from the bursar of the College, Mr. L. G. Troup.

THE fourteenth Cold Spring Harbor Symposium on Quantitative Biology will be held during June 8–16. The topic is "Amino Acids and Proteins", with emphasis on biological aspects of the problem. The meeting will be international in scope, those taking part coming from Denmark (K. Linderstrøm-Lang), France (C. Fromageot), Great Britain (D. Crowfoot, J. F. Danielli, F. Sanger and R. L. M. Synge), and Sweden (K. O. Pedersen). Attendance is restricted, on account of limitations of space, to about a hundred. The programme and other information can be obtained from the Biological Laboratory, Cold Spring Harbor, New York.

THE Chemical Research Laboratory (Department of Scientific and Industrial Research), at Teddington, Middlesex, is again holding a series of 'open days' this year. There will be three sessions, on June 30 (afternoon), and on July 1 (morning and afternoon). Applications from industrial firms wishing to send representatives should be sent to the Director before June 20; those already on the invitation list need not apply again.

PROF. C. K. INGOLD points out that extended series of Fermi doublets of the kind that Prof. R. K. Asundi and M. E. Padhye report (*Nature*, April 23, p. 638) in the near ultra-violet emission spectrum of benzene, as well as analogous series in the absorption spectrum, have been fully described and discussed by Dr. F. M. Garforth and himself (*J. Chem. Soc.*, 417, 427; 1948).

REFERENCE was made in the leading article of *Nature* of May 7 to a recently published book "The Unity of European History" (London: Jonathan Cape, Ltd., 18*s*. net), by Mr. John Bowle. We regret that, throughout the article, the author's name was spelled incorrectly.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Role of Formaldehyde in the Oxidation of Ethylene

At temperatures above 300° C. the reaction of oxygen with methane or ethylene shows the induction period and exponential development of the reaction rate with time, which are two of the characteristics of chain reactions that proceed by degenerate branching, that is, reactions in which the chains are initiated by the subsequent reaction of a fairly stable intermediate produced in the primary reaction process. To substantiate this hypothesis, it is clearly important to discover the nature of the intermediate by which the chains characteristic of degenerate branching are initiated.

Norrish and Foord[1] have concluded from a study of the kinetics of the oxidation of methane that formaldehyde is the important intermediate in this reaction. Since more detailed information on the oxidation of formaldehyde has become available[2], we have developed and applied a more detailed scheme[3] to interpret both the previously observed kinetics of the oxidation of methane and also the results we have obtained from our recent work on the oxidation of ethylene. We find that the concentration of formaldehyde in a reacting mixture of ethylene and oxygen develops to a maximum as the maximum rate is attained, and that the maximum concentration is proportional to the ethylene concentration. These are two examples of the behaviour that would be expected of the intermediate that gives rise to degenerate branching.

We also find that the activation energy (E_A) of the ethylene oxidation varies smoothly from 26 kcal. below 400° C. to 53 kcal. at 550° C., and furthermore that throughout this range of temperatures all the characteristics of degenerate branching are preserved without discontinuity.

The chief contribution to the activation energy must be from the degenerate branching reaction by which chains are initiated from the unstable intermediate; for the primary initiation process is insignificant as soon as the reaction begins to develop, and the reactions between radicals and molecules which propagate the chains have of necessity activation energies much smaller than the activation energies of reactions which start new chains. If, therefore, the degenerate branching process is identical with that by which the intermediate produces chains in its own oxidation, the activation energy of the latter should vary in like manner to that of the ethylene oxidation in the same temperature-range.

In confirmation of this, we find that while the energy of activation of the oxidation of formaldehyde in the range 300–370° C. is *c.* 21 kcal. as observed by previous workers, it rises with increase in temperature to a value of 39 kcal. in the range 450–470° C., at which temperature the activation energy of the ethylene oxidation is 42 kcal. These measurements were made by a comparison of the initial reaction velocities at different temperatures, but could not be extended above 470° C. because the reaction became self-heating. Measurements of the ignition limits, however, in the region 500–550° C. indicate that the activation energy exceeds 40 kcal., though there is some uncertainty by how much because of our lack of knowledge of the precise order of the reaction in this range.

We regard this parallel trend in the activation energies of the two reactions as strong support for our theory that formaldehyde is the agent by which degenerate branching takes place in the oxidation of ethylene. It indicates further that there are two mechanisms of chain initiation in the oxidation of formaldehyde. In the low temperature-range, the reaction, suggested by Axford and Norrish[2],

$$HCHO + O_2 = (HCOOOH) = HCOOH + O,$$

which is approximately thermoneutral[4], is consistent with an overall activation energy of 21 kcal. In the high temperature-range, the reaction may be

$$HCHO + O_2 = \begin{matrix} HCO + HO_2 \\ \searrow \\ H + CO \end{matrix}.$$

The energy-change of this reaction cannot as yet be stated unequivocally, but as a rough estimate, if the reaction $H + O_2 = HO_2$ is 50 kcal. exothermic[4], then the reaction is *c.* 50 kcal. endothermic. Since the energy of activation must be at least as great as the endothermicity, we may conclude that this could be the initiation reaction at temperatures above 500° C.

A. J. Harding
R. G. W. Norrish

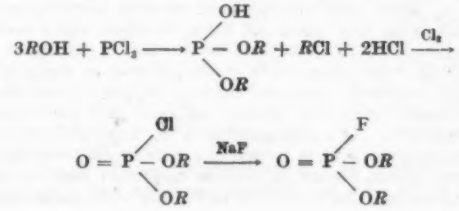
Department of Physical Chemistry,
University, Cambridge.
March 18.

[1] Norrish and Foord, *Proc. Roy. Soc.*, A, **157**, 503 (1936).
[2] Axford and Norrish, *Proc. Roy. Soc.*, A, **198**, 518 (1948).
[3] (*a*) Norrish, Com. to the Centre National de la Recherche Scientifique, Paris, 1948 (in course of publication). (*b*) Harding and Norrish, "Oxidation of Ethylene" (in course of publication).
[4] Data from Bichowsky and Rossini, "Thermochemistry of Chemical Substances" (Reinhold Publishing Corporation, New York, 1936).
[5] Bray, *J. Amer. Chem. Soc.*, **60**, 82 (1938).

Radioactive Di*iso*propyl Fluorophosphonate

Di*iso*propyl fluorophosphonate containing labelled phosphorus (P^{32}) has recently been prepared in this Laboratory. Phosphorus (of the order of 1 gm.) containing P^{32} was converted into phosphorus trichloride. This small-scale conversion presented considerable initial difficulties, the most serious feature being the facile production of phosphorus pentachloride; most reliable descriptions of the preparation of phosphorus trichloride are on a basis of 200 gm. of phosphorus[1]. A communication to the *Journal of the Chemical Society* will give details of the methods employed to overcome these difficulties.

The active trichloride was converted into di*iso*propyl hydrogen phosphite, and thence through the chlorophosphonate to the fluorophosphonate, using the general principles as set forth by Saunders *et al.*[2].



Modified apparatus and techniques were, of course, required: (*a*) because of the small scale of the operations; (*b*) on account of the volatility of the active intermediates and final product.

It is considered that the above direct method of preparing radioactive di*iso*propyl fluorophosphonate possesses advantages compared with the method of B. Witten and J. I. Miller, which starts with radioactive potassium dihydrogen phosphate[3].

We are grateful to the Chief Scientist, Ministry of Supply, for permission to publish this communication, and we wish to thank Dr. A. G. Maddock for his valuable advice in connexion with the investigation.

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March 16.

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Extraction of Pantothenic Acid from Natural Materials

The usual method for the extraction of pantothenic acid from natural materials preparatory to microbiological assay consists of heating at about neutral *p*H, followed by incubation with enzymes at *p*H 4–5 for twenty-four hours or longer[1,2].

In certain cases it is possible to increase the amounts of pantothenic acid extracted by 200–400 per cent by cold alkali treatment prior to enzyme treatment. The highest values for malt observed have been obtained by the following technique: steam 1 gm. of material for 30 min. in 25 ml. of 0·1 *M* sodium acetate, cool, add 5 ml. of 10 *N* sodium hydroxide, allow to stand at room temperature for 5 min., add sufficient sulphuric acid to make slightly acid, adjust to *p*H 4·5, add 0·5 gm. of papain and 0·5 gm. of takadiastase of known pantothenic acid content, incubate for three days at 37° C. under toluene, filter and make up to a known volume at *p*H 6·8.

Using this procedure, followed by acidimetric *Lactobacillus arabinosus* microbiological assay, the measurable pantothenic acid content of a sample of malt was increased to 13 μgm./gm. from a value of 5 μgm./gm. liberated by the normal steaming and enzyme treatment. Fat extraction with petroleum ether after enzyme treatment did not significantly affect the results. In the case of malt extract, a value of 7 μgm./gm. obtained by the usual enzyme treatment was increased to 24 μgm./gm. by soda treatment only. Further treatment with enzymes did not significantly increase this figure. The same increase in apparent pantothenic acid content on treatment with soda was obtained when *Saccharomyces carlsbergensis* "4228" was used as the test organism.

Malt wort behaved in a similar way to malt and malt extract, whereas animal muscle, yeast and molasses were not greatly affected by the alkali treatment. It is suggested that in plant products the pantothenic acid is present in a different form from that which occurs in animal materials and micro-organisms. The exceptional response of molasses may be due to the rather drastic purification process to which it has been subjected.

A full account of this work will be published elsewhere.

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Reactivity of the Sulphur Linkage in Wool

The view that disulphide bond breakdown in the cuticle of wool fibres is responsible for their resistance to felting after treatment with chlorine, sodium hydroxide and sulphuryl chloride has been confirmed[1] by showing that wool treated with 0·1 *N* sodium hydroxide solution for 10–24 hr. at 22·2° C. is more resistant to these reagents than untreated wool. Treatment with sodium hydroxide was believed to convert a high proportion of the disulphide bonds into the more resistant lanthionine and —CH=N— cross-linkages; but since there is now doubt[2] about the existence of the latter in alkali-treated wool, it seemed advisable to repeat the experiments with wool which had been treated with potassium cyanide. Cuthbertson and Phillips have shown[3] that most of the cystine in loose wool is converted into lanthionine by treatment with a 1 per cent solution of potassium cyanide for only 30 min. at 66° C.:

$$R\text{—S—S—}R \xrightarrow{\text{KCN}} R.\text{SK} + R.\text{SCN} \rightarrow R\text{—S—}R + \text{KCNS}.$$

Two 2·5-gm. patterns of an all-wool flannel were therefore immersed in 500 c.c. of a 0·1 *M* solution of potassium cyanide for 3 hr. at 65° C. After being washed in running water overnight, the patterns were squeezed and conditioned in a room at 65 per cent humidity and 22·2° C. One of the patterns was then treated with 4 per cent of chlorine (on the weight of the wool) in a buffer solution at *p*H 4. After excess chlorine had been removed with a 0·5 per cent solution of sodium bisulphite, the fabric was neutralized with 0·5 per cent sodium bicarbonate solution and washed in running water overnight. An untreated pattern of flannel was chlorinated in the same way, and the three patterns, with a sample of untreated flannel, were milled together by hand in 5 per cent soap solution.

The resulting shrinkages are given in the accompanying table, which includes corresponding data for 2·5-gm. conditioned patterns treated with either 100 c.c. of a 0·75 per cent solution of potassium hydroxide in 97 per cent alcohol for 35 minutes at 25° C., or with 100 c.c. of a 2·5 per cent (v/v) solution of sulphuryl chloride in carbon tetrachloride for 1 hr. at 22·2° C. In the second case, 1 per cent of oleic acid was first added to the patterns from alcoholic solution in order to promote reaction with sulphuryl chloride[3]. The table also includes data obtained in a parallel series of experiments with patterns which had been treated with 0·1 *M* potassium cyanide solution for 24 hr. at 65° C. In all cases, the shrinkages are based on the wetted-out areas of the patterns immediately before milling.

Treatment	Percentage shrinkage in area of patterns in: Series I (3 hr.)	Series II (24 hr.)
None	43·0	44·5
Chlorine	4·7	1·1
Potassium cyanide	22·9	28·8
Potassium cyanide and chlorine	23·1	29·0
None	46·0	42·5
Potassium hydroxide	16·1	1·7
Potassium cyanide	28·0	23·0
Potassium cyanide and potassium hydroxide	28·1	21·7
None	38·1	38·5
Sulphuryl chloride	3·2	4·4
Potassium cyanide	22·9	25·5
Potassium cyanide and sulphuryl chloride	24·0	23·7

The above results are even more convincing than those previously obtained with alkali-treated wool. When a high proportion of the cystine in wool is converted into lanthionine by means of potassium cyanide, neither chlorine, potassium hydroxide nor sulphuryl chloride is capable of giving unshrinkability, showing that disulphide bond breakdown is the cause of the unshrinkability imparted to untreated wool by these reagents.

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Role of Tryptophan in the Biosynthesis of Nicotinamide

During an examination of the chemical mechanism of the so-called "conversion of tryptophan into nicotinamide"[1], it was hoped to obtain some elucidation of the supposed pathway from tryptophan to nicotinamide by studying *in vitro* the effect of various methyl-substituted tryptophans on the biosynthesis of nicotinamide by a pure strain of *Bact. coli* (type I fæcal[2]) isolated from the rat's fæces. It was found that when 2-, 4-, 5- and 7-methyl tryptophans, prepared and kindly supplied by Dr. H. N. Rydon[3], and N_1-methyl tryptophan isolated from the seeds of *Abrus precatorius* in concentrations of 2 m*M* were each incubated with the *B. coli* in an ammonium lactate medium[4] containing 2 m*M* of L-ornithine, the first four completely inhibited the biosynthesis of nicotinamide without affecting the growth, and the N_1-methyl tryptophan behaved like tryptophan. This, indeed, indicates that tryptophan is specifically involved in the biosynthesis of nicotinamide. But recent findings[1] showed that nicotinamide methochloride, which is eliminated after administration to dogs, rabbits or rats of DL-tryptophan-β-C^{14}, did not contain the radioactive carbon. It therefore appears more likely that tryptophan acts as some sort of catalyst rather than by taking part directly in the reaction. To test this hypothesis the following series of experiments were carried out.

(*a*) The tryptophan and nicotinamide content of medium and organism were assayed before and after incubation of *Bact. coli* in ammonium lactate in the absence and presence of tryptophan. Similar experiments were carried out with washed *Bact. coli* cells. In the absence of tryptophan, no formation of tryptophan could be observed with the assay method used[5]. When tryptophan was present, changes in tryptophan content observed were within the error limit of the assay method.

(*b*) The washed *coli* were broken up mechanically[7]. A portion of the disintegrated cells was repeatedly washed with saline, and part of the saline washings was dialysed against saline. The five preparations, namely, the washed *coli*, the broken-up cells, the undialysed, the dialysed washings and the exhaustively washed cell fragments were each incubated in ammonium lactate medium[4] alone and in the presence of tryptophan, ornithine or both ornithine and tryptophan for 48 hr., and the nicotinamide content was assayed microbiologically[6]. Parallel experiments were carried out in a medium in which the ammonium salts and lactic acid of the Fildes medium were replaced by equivalent amounts of sodium chloride, glucose being added as source of energy on some occasions.

While no nicotinamide formation occurred with the washed cell fragments, the other four preparations gave the following essentially similar results, indicating that the enzyme system involved was contained in the washings: (1) No nicotinamide was formed in the presence of tryptophan in saline phosphate medium with or without glucose. (2) Nicotinamide was produced in ammonium lactate medium alone, and the amount formed was increased 3–7 times when tryptophan was added. (3) Nicotinamide was formed both in saline phosphate and slightly more in ammonium lactate medium when ornithine was present. Nicotinamide formation in the presence of ornithine was not increased in saline phosphate and only slightly in ammonium lactate medium when tryptophan was added.

The insignificant changes in tryptophan content during the synthesis of nicotinamide on one hand, and the failure of the enzyme system to synthesize nicotinamide in the presence of tryptophan when no ammonium lactate was added, on the other, made it probable that tryptophan is not directly converted into nicotinamide, and suggest that it might take the role of a catalyst in this process. It is possible that ornithine may be formed as an intermediate in the biosynthesis of nicotinamide[1]. If this is so, the failure of tryptophan to stimulate nicotinamide formation in the presence of ornithine suggests that tryptophan may act in the earlier stages of the biosynthesis by stimulating the formation of ornithine.

In rats, tryptophan also increases the biosynthesis of nicotinamide. This is demonstrated by the increased urinary nicotinamide methochloride elimination. This increase is mainly due to the activity of the intestinal flora[1]. When increasing doses of tryptophan are fed to rats, there is a limit beyond which the nicotinamide methochloride elimination is not further increased. When nicotinamide is fed, however, the output of its methyl derivative is proportional to the doses administered, to a level more than ten times as high as that of the tryptophan optimum. This observation also favours the conception of a catalytic action of tryptophan in the nicotinamide biosynthesis. A similar catalytic function was recently attributed to nicotinic acid in the formation of lactic acid by *Lactobacillus arabinosus*[8].

Details of these experiments will be published elsewhere. The work was carried out with a grant for

expenses from the Medical Research Council to one of the authors (P. E.).

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Use of L-Thyroxine by Mouth for Stimulating Milk Secretion in Lactating Cows

SINCE it was first unequivocally shown that the milk yield of lactating cows could be increased by feeding dried thyroid gland[1] or injecting thyroxine[2,3], many experiments (see Reineke[4] for review of some of them) have been carried out on the practical use of thyroid-active substances for increasing the milk yield of cows over limited periods of time. Dried thyroid gland and, more recently, iodo-casein (an artificially prepared thyroid-active protein) have been preferred to synthetic thyroxine for this purpose, because of the high cost of the latter and the belief that its activity was not great by the oral route.

In any event, the galactopoietic effects of thyroxine administered to cows by mouth have not yet, so far as we know, been investigated. However, the recent development of new methods for the synthesis, first of racemic thyroxine[5], and later of L-thyroxine[6], which holds out considerable promise that thyroxine will eventually be made available on a large scale at a cost low enough to compete with iodo-casein, has now prompted an investigation of the effects of thyroxine, given by mouth, on the milk yield of cows in declining lactation.

Dose/cow/day	Milk yield increase (lb./cow/day)		Heart-rate increase (beats/cow/min.)	
	after 2 weeks	after 3 weeks	after 2 weeks	after 3 weeks
25 mgm. L-thyroxine	1·5	1·6	1·8	5·2
50 mgm. "	3·2	3·6	6·2	8·7
100 mgm. "	6·2	5·9	13·5	15·5
150 mgm. "	6·3	6·3	16·9	21·5
15 gm. iodo-casein	4·9	4·3	7·4	11·2

Forty-eight cows in equal numbers on two farms, comprising eight blocks each of six matched cows, that is, six treatment groups, were used in an experiment involving the feeding of L-thyroxine (as sodium salt) at four dose-levels, iodo-casein at one, and a control group. The thyroxine, incorporated with oatmeal and made into tablets each containing 25 mgm., was fed twice daily for 21 days. The responses given in the accompanying table were calculated from the means of readings for the 12th, 13th and 14th days, and the 19th, 20th and 21st days respectively. In the case of milk yield, the figures for the three days immediately before treatment started were used as a standard of comparison, the responses being calculated by the formula: (milk yield of treated cows in treatment period − milk yield of control cows in treatment period) − (milk yield of treated cows in control period − milk yield of control cows in control period).

It will be seen that at the three lower dose-levels of thyroxine graded responses were obtained both with milk yield and heart-rate; but 150 mgm. appeared to be an overdose, as evidenced by slight sweating of a few cows after fourteen days. The 15 gm. of iodo-casein, which was chosen as the optimum dose of that preparation, was estimated by linear interpolation to be equivalent to 60–78 mgm. of L-thyroxine. Since iodo-casein is believed to contain about 3 per cent L-thyroxine[4], this comparison raises the alternative possibilities that these published estimates of the thyroxine content of iodo-casein preparations are in error, or that the efficiency of oral utilization of thyroxine combined in iodo-casein is much lower than that of the pure hormone.

In a previous experiment involving fourteen daily subcutaneous injections of 10 mgm. DL-thyroxine into lactating cows, Folley and White[9] obtained a response at the end of the second week of the injection period amounting to approximately 5 lb. milk/cow/day. From the data in the table, linear interpolation shows that a response of about this magnitude was given by approximately 82 mgm. L-thyroxine administered by mouth. Taking the relative biological activities of L- and DL-thyroxine as very near 2 : 1[4,7], it follows that the oral/parenteral ratio for L-thyroxine in the cow is approximately 16 : 1.

The effects of the treatments on the fat and non-fatty solids (no significant changes), lactose, protein and nitrogen distribution of the milk have been studied by Dr. S. J. Rowland; on certain milk vitamins by Dr. S. Y. Thompson; and on milk iodine by Dr. H. H. Green. These results, together with the changes in milk phosphatase, will be fully reported later.

Since these results seem to open up the possibility of using synthetic L-thyroxine in practice for stimulating milk yield in cattle, an examination of the advantages of the pure hormone over iodo-casein may be of interest. These are: (*a*) there is no necessity for bioassay, a troublesome and unreliable procedure unavoidable with iodo-casein; (*b*) the total iodine fed is much less than with a dose of iodo-casein of equal activity and there is no risk of iodism; and (*c*) L-thyroxine seems to be virtually tasteless and when incorporated into suitable tablets is readily eaten by cows, which is not always the case with iodo-casein.

Our thanks are due to Dr. T. F. Macrae, of Glaxo Laboratories, Ltd., for the L-thyroxine, and to the Agricultural Research Council for a research grant to one of us (G. L. B.).

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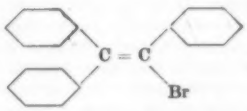
Metabolism of the Œstrogen Triphenylbromoethylene

THIS work was undertaken to investigate the metabolism in mice of the synthetic œstrogen triphenylbromoethylene, using radioactive tracer methods. It was felt important to study further the possibility of a selective absorption leading to the concentration of radioactivity in certain organs. We have been unable to confirm the finding of Daudel and his colleagues that a selective absorption occurs in certain organs, notably the ovaries of mice[1]. Nevertheless, other information of interest was obtained on the metabolism of the drug.

Triphenylbromoethylene has the following structure:



and was made by the bromination of triphenylethylene using bromine containing the radioactive isotope bromine-82 (half-life 34 hours) in a concentration of about 5×10^{-6}. The radioactive bromine was obtained by irradiation of bromoform in the uranium pile at the Atomic Energy Research Establishment, Harwell, and extracted by the Szilard–Chalmers method. Pure-bred strains of mice were used and the investigation extended to two human subjects. The mice were injected either intravenously with 1 mgm. of the drug dispersed in water using a dispersing agent, or subcutaneously in the back with 1 or 5 mgm. dissolved in olive oil.

The amount of bromine retained in the mouse at various times after injection was determined from the gamma-ray activity of the mouse, using a Geiger counter. This is shown in Fig. 1 for both subcutaneous and intravenous injection. It will be seen that the rate of elimination after subcutaneous injection is low. This is due to the slow absorption from the

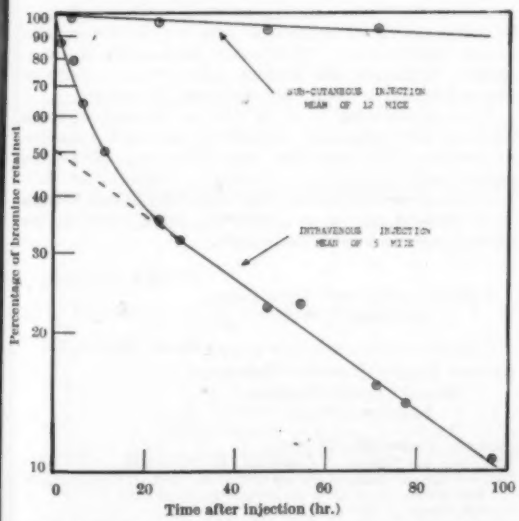


Fig. 1. Retention of bromine in mice after injection of triphenylbromoethylene

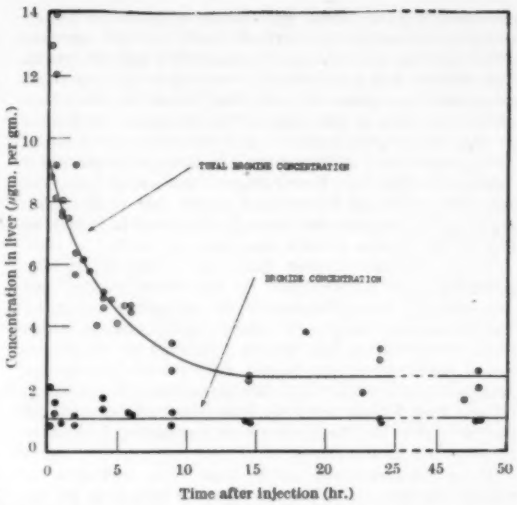


Fig. 2. Total bromine and bromide concentration in liver of mice after intravenous injection of triphenylbromoethylene

injection site, since removal at 216 hours of the subcutaneous tissue containing the injected oil showed it to retain almost all the radioactivity. The curve representing the elimination of bromine after intravenous injection indicates two very distinct rates of elimination. The results suggest that 49 per cent of the total bromine is eliminated in an exponential manner with a half-period in the body of 4·2 hr.; the remaining 51 per cent is also eliminated exponentially, with a half-period of 41 hr. This indicates that the bromine is eliminated as at least two distinct metabolites. Similar experiments showed that bromine injected intravenously in the form of sodium bromide was eliminated with a half-period of 31 hr. This finding suggested that the metabolite responsible for the long half-period was largely inorganic bromide.

To gain further information on the process of metabolism of the drug, the bromine content of blood, kidney and liver tissue was measured at intervals after intravenous injection. The tissues were ground to form a suspension in water and the bromine content determined from the β-activity, using a Geiger counter suitable for liquid samples[2]. Owing to the rather coarse nature of the dispersion of the drug, it was found difficult to inject each mouse with exactly the same quantity, so that there was considerable scatter of the bromine content of individual mice. Nevertheless, it was clear that the concentration in both blood and kidney was constant over the time of the experiments, the average concentration in the blood being 3·6 μgm. of bromine per gm. and in the kidney 65 per cent of this value. The liver concentration was high 15 minutes after injection, and fell rapidly with a half-period of 3·0 hr. to 66 per cent of that in the blood. This is shown in Fig. 2; the concentrations in the liver of each mouse have been adjusted to correspond with the constant blood concentration of 3·6 μgm. of bromine per gm.

The proportion of bromine in inorganic form in these organs was determined by first precipitating the protein with trichloracetic acid and thereafter

precipitating the halide with silver nitrate. To verify that no bromide was carried down by the protein precipitation, similar experiments were done in which radioactive sodium bromide was injected into mice or added to organs *in vitro*, and these showed that on the average 91 per cent of the bromine was found in the silver precipitate. The fraction of bromine in the blood and kidney that was inorganic increased during the first two hours after intravenous injection and then remained constant at 93 per cent. The amount of inorganic bromide in the liver is shown in Fig. 2 and is seen to be constant.

These results suggest that the drug is rapidly absorbed and metabolized by the liver, about half the bromine being liberated as inorganic bromide, the remainder as one or more organic metabolites. Most of the latter are rapidly excreted in the fæces. These conclusions are borne out by metabolism experiments after subcutaneous injection of the drug. It was found that after several days, 95 per cent of the bromine in the urine was inorganic, but only 43 per cent in the fæces.

These experiments show that this œstrogen is rapidly broken up after absorption, but give no indication as to whether œstrogenic action is due to small amounts of unchanged drug, or to one of the metabolites formed. In particular, the effect may well be due to a metabolite which does not contain bromine.

The investigation was extended by the administration of triphenylbromoethylene to two human subjects. In one case the drug was given subcutaneously in oil, in the other orally, and the activity in the blood and the elimination in urine and fæces was followed. The few results obtained are consistent with the view that the metabolism of the drug in the human subject is similar to that in the mouse.

The full results will be reported elsewhere.

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Mode of Action of Basic Antibacterial Substances

That spermine and streptomycin "do not affect the respiration of yeast and thus have no direct bactericidal activity", as stated by Massart[1], is a conclusion with which many will not agree. Apart from the dangers inherent in applying to bacteria results which have been obtained with yeast, there are few grounds for supposing that the facility with which a drug can impair bacterial respiration bears any simple relation to its growth-inhibiting properties. Indeed, Ferguson and Thorne[2] have shown that the order in which six aminoacridines repress the respiration of *B. coli* (when the substrates were glucose, pyruvic acid, lactic acid, asparagin or oleic acid) bears no obvious relation to the order of their activity in retarding the growth of this bacterium.

Some will also question Massart's conclusion that 'polymerization' (that is, micelle formation) makes an important contribution to the antibacterial action of his test substances (trypaflavine, methylene blue, crystal violet and quinine) by increasing their effective molecular weight.

In the acridine series (of which trypaflavine is a member) the critical micelle concentration has been investigated by one of us (R. J. G.) using three criteria: (i) deviation from Beer's Law; (ii) conductimetric maxima; and (iii) formation of blue colour with potassium tri-iodide. It was found that this concentration often lay well above the minimal antibacterial concentration. Furthermore, it is easy to point out pairs of closely related drugs where a rise in critical micelle concentration is accompanied by heightened antibacterial activity. For example, 5-amino-1-methylacridine, because of a steric effect, does not reach its critical micelle concentration until the solution is twice as concentrated as is necessary in the case of 5-aminoacridine; yet the former is bacteriostatic, for example, to *Streptococcus pyogenes*, at half the minimal effective concentration of the latter[3].

Prof. Massart's argument depends upon the assumption that the critical micelle concentrations of spermine and streptomycin are higher than those of quinine and the dyes. Although the highly polar character of spermine and streptomycin makes this likely, no actual figures have been published.

It has often been observed that, in a series of cationic substances, an increase in the molecular weight goes parallel with increased antibacterial activity (Albert[4], quoted by Massart through Dubos[5]), and the following explanation of this phenomenon has been given. "This requirement of size is to provide a sufficiently great area for adsorption; it depends on the fact that increase in the number of atoms in a molecule increases its Van der Waals' attraction, while the kinetic energy of translation, which is the force tending to remove the molecule, is independent of molecular size"[3]. However, the forces used up by trypaflavine and other dyes in micelle formation are scarcely likely to be available for combination with the bacterial receptors.

It is appreciated that, in a series of amines, some physical properties are dependent upon the presence of micelles (for example, the formation of a blue colour with potassium tri-iodide). But other properties, particularly those which involve accumulation at a surface, are at a maximum when micelles are absent (for example, foaming[6]).

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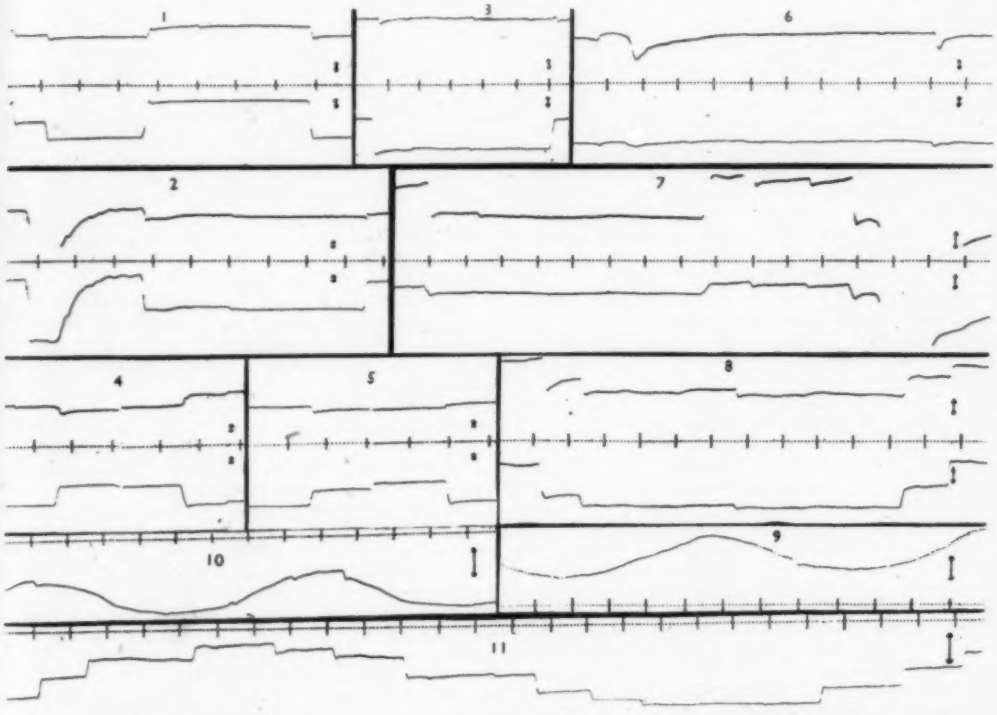
Small Voluntary Flicking and Following Eye Movements

THE apparatus for studying eye movements previously described[1,2] has been modified by replacing the straight edges by 1-in. square neutral density wedges. Larger excursions of the eye can thus be recorded although the sensitivity is reduced. The purpose of the experiments described here has been to study eye movements when the direction of regard is consciously shifted from one fixation point to another, and also when fixating on a point performing either horizontal or vertical oscillations. The angle subtended by the oscillations and by the separation of the points was in the range 1–4° and is, we believe, smaller than any which has been mentioned in previous publications. Records have been obtained for horizontal, vertical and oblique separations of the points, for movements made at the request of the operator and also in the observer's own time; in the latter case attempts were made at different rates of movement—fast, medium and slow.

It was found that the character of the fast and medium flicks from one point to the other shows some variations (Fig. 1): sometimes there was overshooting and subsequent regression, sometimes the movement occurred in steps; but at times the movement was completed in a single jump. The duration of the flicks was in the range 0·02–0·05 sec.; attempts to increase the rate of flicking from medium to fast produced little increase in the rate of transfer from one point to the other, but increased the frequency of flicking (compare Fig. 2 (medium speed) with Fig. 1 (fast)); there appears to be an upper limit to this frequency of about two flicks per second for both observers. No significant difference was found between the medium-speed request (Fig. 4) and own time (Fig. 5) records. A striking feature of the records of M.P.L. is the change which occurred in the course of the experiments, especially for oblique and vertical point separations: in Figs. 6 and 7 are records taken under similar conditions on May 21, 1948, and September 7, 1948, respectively.



Angular separation of the points in degrees given by value of A; horizontal and vertical directions denoted by H and V respectively.

1 and 2. Respectively medium speed and fast flicks for W.D.W., A = 2½, H.
3. Medium speed flicks for M.P.L., A = 3, H.
4 and 5. Respectively medium speed request and own time flicks for W.D.W., A = 2½, N.E.
6 and 7. Medium speed flicks for M.P.L., A = 3, V.
8. Slow movements for M.P.L., A = 3, S.E.
9. Following movements for M.P.L. for vertical oscillations (up and down component only shown).
10. Following movements for W.D.W. for horizontal oscillations (side-to-side component only shown).
11. Slow movements for W.D.W., A = 2, H (side-to-side component only shown).

Time (increasing to right) marked by dots (50 per sec.) and by lines at 0·2-sec. intervals. Amplitude shown at side: height of arrowed line represents 1°, assuming d = 5·3 mm. Upper record gives up-and-down component; lower record side-to-side component. In Figs. 4 and 5, two separate parts of the records have been brought together to save space

For the slow flicks, the movement, although subjectively smooth, occurs in steps; typical records are shown in Figs. 8 and 11. Smooth continuous movement of the eye is, however, obtained when a moving target is being followed (Figs. 9 and 10). Similar phenomena have been reported previously[3], but the angular displacement is not stated. The records were frequently interrupted by a blink (see Figs. 2 and 7). Visual observation of the ultra-violet beam on the fluorescent screen[1] during deliberate blinking shows that the eye initially moves upwards and possibly inwards as has been previously reported[4]. The eye movements cannot, however, be directly deduced from the blink records, because the latter are also affected by the movement of the lids across the ultra-violet beam.

It appears from the records (Figs. 1, 2, 3, 6 and 7) that for horizontal and vertical separations the movement is sometimes not confined to one direction. This may be due to a slight lack of parallelism between the direction of the fixation points and that of increasing density of one wedge. However, it would seem that the effect is frequently somewhat large for this to be the whole explanation. The angular differences in fixation direction for the various movements cannot easily be deduced from the records, because the sensitivity of the apparatus is approximately proportional to the distance (d) of the centre of curvature of the cornea from the centre of rotation of the eye, which may vary with the type of movement[5,6]. On the assumption that the average difference in fixation direction was given by the angular separation of the points, information could be deduced about the behaviour of the centre of rotation. On this hypothesis, records for W.D.W. for horizontal separations for slow flicking and for vertical separations except for slow flicking, and all records for M.P.L. for horizontal separations, would be consistent with a value of 5·3 mm. for d. For vertical separations, for slow flicking for W.D.W. and under all conditions for M.P.L., the value would be about 3·5 mm., while the remaining records for horizontal separations for W.D.W. would give $d = 8$ mm. For oblique separations, except the south-east direction for W.D.W., the records might indicate that the value of d for the side-to-side component is, in general, greater than for the up-and-down component.

Alternatively, we might assume that the line of regard does not always pass through the anatomical centre of the fovea, its retinal intersection for any set of conditions being determined by a variety of factors: physiological, psychological and psycho-physical. We would emphasize that subjective impressions are not wholly reliable indications of eye movements; neither observer was aware of many of the features of the records described here.

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Colour Vision of Heterozygotes for Sex-linked Red-Green Defects

SEX-LINKED red-green colour vision defects are incompletely recessive, since the heterozygotes for these defects and the normal condition usually have small red-green defects[1-3], or may occasionally manifest the major defects themselves[4]. Details of the relationships between the different defective allelomorphs[5] and the small defects of these heterozygotes have not been fully revealed; but the appended table shows the most marked characteristics of the red-green vision of seventy-three women (not major defectives) who have relatives with major defects, classified according to the defects of those relatives.

Grouping of relatives	Normal	Grouping of women: Red-green weak	Green deviant	Red deviant
Protanope	6	9	1	5
Deuteranope	6	20	4	0
Green anomalous	6	1	10	1
Red anomalous	2	1	0	1

'Red-green weakness' may be defined as two to four times the modal threshold for the distinction of spectrum red and/or green from spectrum yellow[6,7]. 'Deviants' may be defined as those who have deviations of two to three times sigma in the Rayleigh equation[7]. The red-green blind (protanopes and deuteranopes) are much more extreme than the red-green weak, very rarely having red-green thresholds of less than six times the modal threshold. The red and green anomalous are very much more extreme than the deviants, rarely having deviations of less than six times sigma.

On the hypothesis of incomplete recessiveness, it would be expected that the heterozygotes for the normal condition, together with a major red-green defect, might show very much smaller defects of the same kinds as those of their defective relatives. This expectation is very largely fulfilled. Protanopes and deuteranopes tend to have red-green weak more often than deviant women relatives, while the green anomalous tend to have women relatives who are green deviants more often than red-green weak. Furthermore, some protanopes have big red deviations and some deuteranopes big green deviations in addition to extreme loss of red-green discrimination, though their deviations are seldom as great as those of the truly anomalous; and it is interesting that the table shows that the women relatives of protanopes are more often red than green deviants, while those of deuteranopes are more often deviants in green than in red, when they are not red-green weak. The possible expectation has not been confirmed that the red-green weak women relatives of protanopes might tend to have red of slightly diminished brightness.

If all the women who appear in the table were sisters of defective men, whose fathers were normal and whose mothers were normal heterozygotes, then the chance expectation of heterozygotes among them would be 1 in 2. The observed proportion of colour-weak and deviant subjects is 53/73, and this differs from the proportion of 1/2 by more than is attributable to chance. The discrepancy is due to the presence among these women of some who are daughters of defective men, mothers of defective men or women, or sisters of defective women, among

whom the normal homozygous condition is not expected.

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Symbiosis in Thermophilic Cellulose Fermentation

AN elective culture of anaerobic thermophilic cellulose bacteria was examined by plating with potato infusion agar, to which 0·04 per cent sodium thioglycollate was added. The plates were incubated at 55° C. in carbon dioxide under reduced pressure. It was found that the culture is composed of three different bacteria, only one of which is capable of fermenting cellulose. The cells of the latter are thin rods with spherical terminal spores. On cellulose–dextrin agar, prepared from water-insoluble or water-soluble cellulose dextrin according to Fuller and Norman[1], this organism (provisionally named type *c*) forms small distinct, disk-shaped colonies, surrounded by circular, well-developed decomposition zones (visible also when water-soluble dextrin is used).

That type *c* really was obtained as a pure culture is evident, *inter alia*, from the fact that only colonies with decomposition zones are formed on plating with cellulose–dextrin agar containing potato infusion. When type *c* is transferred to liquid cellulose medium, the solution itself remains perfectly transparent, suggesting that the bacteria are located on the cellulose fibres. Also the appearance of reducing sugars in the medium after the fermentation ceases indicates that the culture is pure.

Besides type *c* the culture contained another morphologically similar organism, provisionally named type *s*. On potato-infusion agar, type *s* forms colonies of the same appearance as type *c*, but does not attack cellulose dextrin. Thus type *s* can easily be separated from type *c*. Unlike type *c*, bacterium *s* produces butyric acid from dextrose.

The cells of the third bacterium of the culture, named type III, are comparatively thick rods with ovoid terminal spores. Unlike the two others, this organism grows well on nutrient agar and can easily be isolated by plating, when this medium is used. Further, types *c* and *s* are obligate anaerobes, but type III must be considered as microaerophilic.

The accompanying table shows the products of the fermentation of cellulose by type *c*, and from dextrose by types *s* and III in pure cultures. In addition, the table shows the products formed when type *c* breaks down cellulose in symbiosis with *s* as well as with *s* and III together.

Type *c* produces mainly lactic acid and also ethanol, formic acid and acetic acid, but no butyric acid. The reducing substance, which is calculated as dextrose in the table, seems to be cellobiose and dextrose.

Type *s* is very similar to type *c* but produces butyric acid too. Type III is the most marked lactic acid producer of the three organisms. It gives no butyric acid.

Fermentation products (gm. per 100 gm. cellulose (or dextrose)) decomposed
Added cellulose: 10 gm. per litre medium.
Added dextrose: 20 gm. per litre medium.
c = pure culture of cellulose-fermenting bacterium.
s = pure culture of dextrose fermenter producing butyric acid.
III = pure culture of dextrose fermenter producing lactic acid.

Culture	*c*	*s*	III	*c*+*s*	*c*+*s*+III
Incubation time (days)	10	6	4	8	6
Carbohydrate source	cellulose	dextrose	dextrose	cellulose	cellulose
Carbohydrate fermented (%)	40·1	100·0	83·1	70·1	100·0
Fermentation products: (gm. per 100 gm. fermented carbohydrate)					
Ethanol	16·0	14·8	8·9	13·7	15·0
Formic acid	5·4	5·4	4·8	1·1	1·7
Acetic acid	19·1	10·4	3·9	42·2	29·0
Butyric acid	0·0	2·5	0·0	14·2	30·0
Lactic acid	43·1	52·5	73·6	9·6	4·8
Reducing substance calculated as dextrose	11·7	—	—	0·0	0·0

When the cellulose medium is inoculated with type *c* and also type *s*, or types *s* and III together, the fermentation time is remarkably shortened. In a liquid cellulose medium containing 1 per cent of cellulose wadding, type *c* did not ferment more than 40 per cent of the cellulose in ten days. In symbiosis with type *s*, type *c* fermented 70 per cent in eight days, and in symbiosis with both *s* and III, 100 per cent was fermented in six days.

The importance of the symbiosis is also evident from the butyric acid production. As a pure culture, type *s* produces only small amounts of butyric acid from dextrose. Together with the cellulose fermenter, it increases the butyric acid production, and when type III is added too, butyric acid is one of the main products. At the same time, the amount of lactic acid decreases, which indicates that the formation of butyric acid is in some way connected with the lactic acid formation.

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Trichinosis in Arctic Animals

IN the spring of 1947 a series of outbreaks of a disease, which at first was considered to be a paratyphoid fever, spread among the native population along the coast of north-western Greenland, particularly in the settlements around Disko Bay. More than three hundred cases with thirty-three deaths occurred. The main clinical symptoms were exanthema, generalized œdema, fever, muscular pain, gastro-intestinal symptoms and myocarditis. A special investigation was made by the State Serum Institute in Copenhagen, and it was proved that the disease was, in fact, trichinosis[1,2]. The diagnosis was verified by the positive reaction of the sera to microscopic precipitin tests with living larvæ of *Trichinella spiralis*[3,4], by demonstration of eosinophilia in the blood picture, by positive skin tests with trichina antigen, and, finally, by the finding of the parasites in the musculature of a patient who had succumbed to the infection. Most of the cases were apparently due to the consumption of walrus meat. Thus, at the settlement of Sukkertoppen, where only two cases occurred, both patients had eaten walrus meat,

which had been sent to them from Holsteinsborg, which was one of the centres of the epidemic.

It was, moreover, now possible to ascertain that some outbreaks which had previously occurred in these districts and at the time had been considered as 'typhoid' or as 'meat poisoning' had also been trichinosis, presumably also due to walrus meat.

In order to find the sources of infection as well as the frequency of trichinosis in the Greenland fauna, the Greenland Government started a collection of meat samples from different mammals in north-western and in eastern Greenland. The samples were dry-salted and were sent to Copenhagen to be examined microscopically for the larvæ of *Trichinella spiralis*. Of dogs and arctic foxes the forelegs were used as samples, of Greenland hares the masseters and of the other animals the diaphragms. For examination the meat was softened in boiling water. Then about one gram of each sample was cut in thin pieces, which were treated with 5 per cent potassium hydroxide and compressed in a 'compressor' between two thick glass plates. The preparations were examined under a low-power microscope.

Up to date the following results have been obtained.

Examined		Infected with *T. spiralis*
66 dogs (*Canis familiaris*)		46
19 polar bears (*Thalarctos maritimus*)		6
101 arctic foxes (*Alopex lagopus*)		3
4 Greenland hares (*Lepus arcticus groenlandicus*)		0
18 rats (*Rattus norvegicus*)		0
133 walruses (*Odobænus rosmarus*)		0
28 bearded seals (*Erignathus barbatus*)		1
2 bladder-nosed seals (*Cystophora cristata*)		0
17 other seals		0
27 white whales (*Delphinapterus leucas*)		0
1 narwhal (*Monodon monoceros*)		0
416 samples	positive	56

The finding of nearly 70 per cent of trichinous animals among sledge dogs is the highest incidence of this parasite ever observed. Next is the frequency of nearly 30 per cent encountered in polar bears, both from north-western and from eastern Greenland. The arctic foxes, with 3 per cent of positive individuals, do not seem to be infected in the same high degree.

Particularly interesting is the find of a heavy infestation with *T. spiralis* in a bearded seal from Thule, the extreme northern district of West Greenland. This is the first observation of the parasite in a marine mammal, making it very obvious that the walrus, too, can occasionally be infected, even though no positive sample has been traced in the walrus material examined up to date.

As was already predicted by Parnell[5] in 1934 and by Leiper[6] in 1938, trichinosis is to be considered as a major problem in the Arctic, and has a direct bearing on the health of the tribes inhabiting those regions as well as on that of explorers and sealers; the infection is, moreover, a danger by incapacitating the sledge dog, so indispensable to man in polar countries.

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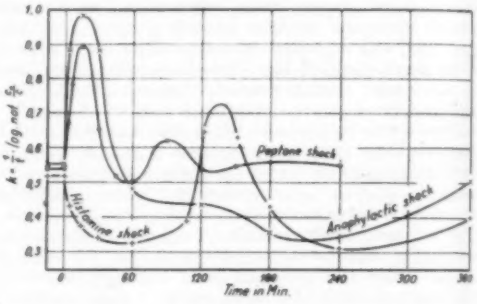
Shock Phenomena and Thrombin Inactivation

IT is known experimentally that changes in blood-clotting occur under shock. In general, the blood takes longer to coagulate in anaphylactic and peptone shock, while in histamine shock the observations made have been rather uncertain. To clear up the question, we have used the method worked out by Gerendàs[1,2] for investigating thrombin inactivation.

(*a*) On giving rabbits intravenously 0·5 mgm. histamine per kilo body-weight[3], we found that the reaction speed of the thrombin inactivation began to slow up, reached a minimum in about 60 minutes and then rose above the initial value; then again it began to decrease, the effect being completed after a few compensatory waves (see graph, histamine curve).

(*b*) On re-injecting rabbits sensitized with horse serum (0·3 ml. intravenously) 14 days later, it was seen[4] that the inactivation was immediately accelerated vigorously, dropped to normal in 60 minutes, after which it made a protracted, slow inactivation deflexion and only thereafter returned to normal (see graph, anaphylactic shock).



(*c*) In peptone shock (0·1 gm. peptone per kgm. rabbit) we again found a very vigorous acceleration in the inactivation[5], which after 60 minutes again returned to the normal value; and then, after a few slight fluctuations (but never dropping below the normal value), returned to its original state (see graph, peptone shock).

Comparison of these curves shows a striking contrast between that of histamine shock and those of anaphylactic and peptone shock.

On giving histamine intravenously, an immediate decrease in inactivation occurs, which tallies well with the effect obtained in our *in vitro* experiments[2] and can be attributed to the histamine binding the free heparin circulating in the blood. At the same time, the well-known symptoms of histamine shock could be seen in the animals.

In anaphylactic and peptone shock, on the contrary, directly after shock ensues, the inactivation increases very decidedly, obviously due to the effect of heparin.

In view of these quite contrary effects, it is surprising that the same symptoms of shock should be observed in the anaphylactic and peptone shock animals as in those treated with histamine. In each case these shock symptoms occur in about three minutes, in spite of the fact that in anaphylactic and peptone shock we see a strong heparin effect at about

three minutes, and heparin—as we know—is never a cause of shock, in fact rather prevents it[6].

The phenomenon can readily be explained if we apply to the tissues the rule[7] of histamine–heparin balance demonstrable in the blood, as shown by earlier investigations of ours. We conclude from it that when heparin streams from the tissues into the blood to prevent the precipitation in it of peptone, or of the antigen–antibody on re-injecting the serum, the histamine–heparin balance of the tissues is destroyed, excess histamine forms and thus produces a shock-causing effect in them. The following experiment gave further support for these conclusions. We gave rabbits intravenously a quantity of toluidine blue (100 mgm.) which, according to our calculations, should bind all the heparin in the circulation. The animals died in a few minutes showing typical symptoms of histamine shock. Through the rapid binding of the heparin, the histamine in the tissues, suddenly released, could thus be made to produce a lethal shock.

Hence the principle of a functional heparin–histamine equilibrium also applies to the tissues, and from it we also obtain an explanation of the changes in blood-clotting occurring during shock.

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Spontaneous and Induced Triploidy in Pre-Implantation Mouse Eggs

Advances in knowledge of plant polyploidy, with their theoretical and practical importance, have led to an interest in polyploidy in the animal kingdom. Among invertebrates, polyploidy is a normal phenomenon in some races (for example, *Artemia salina*[1,2], Curculionidæ[3], *Solenobia*[4], *Trichoniscus*[5]). In vertebrates, a possible polyploid origin of some fish species has been reported[6], and there is now a considerable body of literature on natural and induced polyploidy in Amphibia[7–12]. It would be of interest to extend the study of polyploidy to mammals. The existence of polyploid mammals should throw light on such important problems as, for example, physiological genetics, with special reference to dominance and gene dosage effects in vertebrates[11]. Information should also be gained on sex determination and developmental processes in general. The existence of polyploid mammals might be of medical and economic interest.

At present, polyploidy as established by chromosome counts is unknown in adult mammals. In eggs, the only positive results known to us are those of Pincus and Waddington[12], in which up to four-celled tetraploid rabbit eggs were reported after ether or temperature treatment. Our investigations reported in this preliminary note have demonstrated that eggs with spontaneous or experimentally produced polyploidy can exist at a more advanced stage of development.

We subjected fertilized mouse eggs to conditions designed to retain the maternal chromosomes in diploid number by suppression of the formation of the second polar body, anticipating that triploidy would result. We considered that treatment of tubal eggs *in situ* with cold (ice) or heat (warm water) would involve less handling and fewer after-effects than would chemical treatment or any treatment involving transplantation. At this stage of our work the important point was to establish a reliable method for producing polyploidy, and we therefore limited our observations to pre-implantation eggs taken from the genital tract three and a half days after treatment and examined as squash preparations. This had the advantages that results were available four days after treatment, that the large chromosomes of the pre-implantation stages could be counted with accuracy, and that observations could be made before the less viable eggs were eliminated.

Chromosome counts of untreated eggs from various stocks showed that all analysable eggs were diploid, except in one particular stock (*E*), in which most of the analysable eggs exhibited spontaneous polyploidy in three females examined (see table). The existence of such spontaneous heteroploids in mammals is likely to be a phenomenon of considerable importance in several respects.

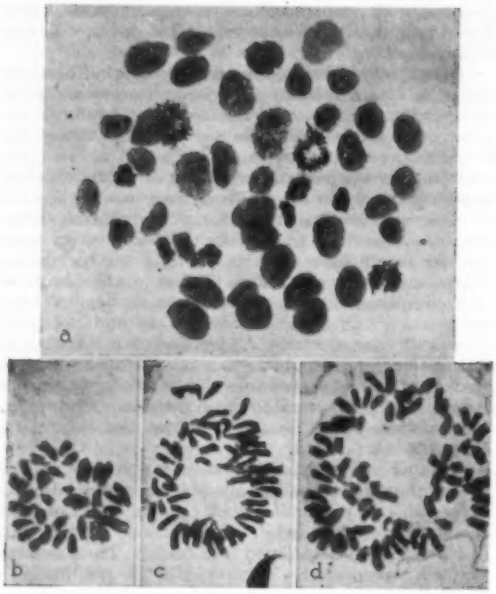
	Treatment		Untreated	
	Cold, *c.* 0° C. 5–21 min.	Hot, 40–48° C. 5–10 min.	*E* stock	Other stocks
No. ♀♀ used	42	51	4	20
No. ♀♀ with eggs	39	39	3	15
Mean eggs per ♀ with eggs	7·7	6·9	6·7	8·8
Classification of eggs:				
Total	301	268	20	132
Uncleaved, unanalysable, dead or lost	216	237	11	95
Haploid	0	1*	0	0
Diploid	82	19	2†	37
Triploid	1	8	5+1‡	0
Tetraploid	0	1	1‡	0
Aneuploid and/or with heteroploid areas	2	2	0	0
Total analysable eggs	85	31	9	37
Total heteroploid eggs	3	11+1*	7+2†	0
Percentage certainly heteroploid	3·5%	35·5%	78%	0·0%

* 18 chromosomes in one mitosis of *c.* 6-cell stage (not certainly haploid).
† Possibly aneuploid.
‡ Certainly polyploid, but degree of polyploidy uncertain.

With regard to the few heteroploid eggs (3·5 per cent) in the cold-shock series, we cannot be certain that these eggs were produced by the treatment itself rather than by females exhibiting spontaneous polyploidy. In the hot-shock experiments, on the other hand, the high percentage of polyploid eggs produced (35·5 per cent) and a regular occurrence of heteroploidy in successive series can safely be ascribed to the treatment.

In all, twenty-two eggs were certainly heteroploid at stages up to blastulæ; of these, at least fourteen were triploid. Many treated eggs appeared to be developing normally, all stages of mitosis being evident (see photograph).

In our preparations no distinction was made between the trophoblast, which gives rise to extra-



a, Squash preparation of triploid mouse egg with various mitotic stages. × 310. *b*, *c*, *d*, Diploid, triploid and tetraploid metaphases from squash preparations, 40, 60 and 80 chromosomes respectively; two chromatids visible in each chromosome. × 1,000 (reduced from photographs, × 2,000)

embryonic structures at a later stage, and the inner cell mass, which gives rise to the embryo proper. However, unless rather unlikely mechanisms are invoked, the occurrence of one or more triploid mitoses in any part of the blastula must mean that the whole egg is triploid.

We are investigating the viability of these polyploid eggs at stages later than the blastula, suitable genetic markings having been arranged to simplify recognition of polyploids.

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Aedes (*Stegomyia*) *pseudoafricanus* sp. nov.: a New Species of *Aedes* from the Coast of Nigeria (British West Africa)

White mangrove trees (*Avicennia nitida* Jacq.) growing in clumps in the spring-tide zone of salt-water swamps near Lagos (Nigeria) contain numerous tree-holes, filled with rain water, in which larvæ of several species of *Aedes* are common. Dalziel[1] and Dunn[2] have found that *A.* (*Stegomyia*) *africanus* Theo. is a common tree-hole breeder in this area.

Closer examination of series of adults bred from larvæ collected in *Avicennia* tree-holes and, particularly, examination of male terminalia, indicate that mosquitoes thought to be *A.* (*S.*) *africanus* are morphologically different from the typical *A.* (*S.*) *africanus* as described by Edwards[3], and will have to be recognized as a new species, *A.* (*Stegomyia*) *pseudoafricanus*.

The morphological differences between larvæ and pupæ of these two mosquitoes are small. The investiture of the mesonotum of female and male specimens of *A.* (*S.*) *pseudoafricanus* is slightly different from the markings found in East African specimens of *A.* (*S.*) *africanus*. (Specimens of the latter were examined through the courtesy of Mrs. E. C. C. van Someren, Government entomologist, Medical Research Laboratory, Nairobi, Kenya.)

The silvery markings on the scutum of *A.* (*S.*) *pseudoafricanus* are not narrowly crescent-shaped as in *A.* (*S.*) *africanus*, but wider, roughly trapezoid and set at a more obtuse angle to the middle line. Also the double median line of broad silvery scales is longer in *A.* (*S.*) *pseudoafricanus*.

The main difference between the two mosquitoes lies in the structure of male terminalia. The terminalia of *A.* (*S.*) *pseudoafricanus* are as follows. Ninth tergite with flat, rather widely separated lobes with five to seven short bristles on each lobe; style, curved, tapering, with a fairly long, dark terminal spine. The basal lobe of the coxite is quite different from that of *A.* (*S.*) *africanus*; it is moderately hairy, roughly conical, with a tapering thumblike projection bearing at the apex two conspicuous curved, thickened bristles. The base of the basal lobe has two rounded prominent folds with thick edges and spiculate emarginations. Paraprocts have the usual basal ventral arm. The phallosome is rounded, with short central teeth and slightly longer basal teeth.

The habitat of *A.* (*S.*) *pseudoafricanus*, as known at the present time, is restricted to the open salt-water swamps, with wide stretches of *Paspalum* grass, coarse ferns (*Acrostichum aureum*) and clumps of low *Avicennia* trees.

The biting cycle and vertical distribution of *A.* (*S.*) *pseudoafricanus* are being investigated. Preliminary catches suggest that this mosquito is predominantly crepuscular and not as strictly arboreal as *A.* (*S.*) *africanus*.

A laboratory colony of *A.* (*S.*) *pseudoafricanus* has been established and has produced three generations.

A preliminary experiment has shown that *A.* (*S.*) *pseudoafricanus* can be infected with the yellow fever virus by feeding it on *Macacus rhesus* inoculated with the yellow fever virus (Strain Ojo 657). Eleven days after the infective feeding the mosquito was ground and injected into white mice, which became ill and died of yellow fever.

The Yellow Fever Research Institute is supported by the Rockefeller Foundation, the Governments of the British West African Colonies and the Colonial Medical Research Service.

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Feb. 10.

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Overlapping of Dust Particles on a Sampling Plate

IF, in a dust sample intended for microscopic examination, the number of particles per unit area were too large, some of the particles would overlap. Such 'clumps' would be counted as single particles instead of two, three or more, and the total count would be too low. The following analysis gives an indication of the magnitude of this effect. We shall assume that the particles may be regarded as circular laminæ of diameter d, and that their centres are distributed randomly over an area A. If the particles were of highly irregular shape and size, the present results might be invalid.

Any individual particle will be overlapped by $r-1$ other particles if $r-1$ centres fall within the circle with centre coinciding with the given particle centre, and radius d. If we assumed that in all clumps of order r, each of the r particles overlapped all the others, the probability that a particle would belong to a clump of order r would be (for large N)

$$\frac{\exp(-m')\,(m')^{r-1}}{(r-1)\,!},$$

where $m' = N\pi d^2/A$, N/A being the mean number of centres per unit area.

If, on the average, P_r clumps of order r were observed (so that $\sum_{r=1}^{\infty} P_r = C$, the number of clumps counted, and $\sum_{r=1}^{\infty} rP_r = N$), we should have

$$rP_r = \frac{N\exp(-m')\,(m)^{r-1}}{(r-1)\,!},$$

$$\therefore\ P_r = \left(\frac{N\exp(-m')}{m'}\right)\cdot\frac{(m')^r}{r\,!},$$

so that the clump-size r follows a curtailed Poisson distribution (with missing zero term).

If $m = N/C$ is the mean clump-size,

$$m = \frac{N\pi d^2/A}{1-\exp(-N\pi d^2/A)}. \qquad (1)$$

This analysis may be expected to be inexact when the frequency of clumps of more than two particles is appreciable. In such cases the frequencies P_r, for high values of r, are much higher than we should expect, owing to the existence of clumps in the form of chains, and the mean m is also increased. As $N\pi d^2/A \to 0$, m tends to the value given in (1). Sampling experiments with random numbers have shown that (1) appears to under-estimate the true value of m by less than 10 per cent, even for values of Nd^2/A as high as 0·3. In practical work, concentrations should be considerably less than this.

For given values of C, d and A, we may estimate m by transforming equation (1) to the following:

$$m = \frac{-A}{C\pi d^2}\log_e\left(1-\frac{C\pi d^2}{A}\right), \qquad (2)$$

m' (if required) being obtained from the equation

$$m = \frac{m'}{1-\exp(-m')}.$$

In order to reduce the percentage error of overlapping, $100(N-C)/C$, to less than 5 per cent, we need $m < 1{\cdot}05$, which from (2) is equivalent to

$$C < A/10{\cdot}7\pi d^2 = 0{\cdot}0297\,A/d^2.$$

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Dispersibility of Coal in a Supersonic Field

IN the course of experiments on the solubility (or dispersibility) of coals in organic solvents, it was observed that the pyridine-insoluble (α) fraction of a Northumberland coal (82·6 per cent carbon and 5·1 per cent hydrogen on the dry ash-free basis) became partially dissolved (or dispersed) when suspended in pure dry pyridine and exposed to supersonic waves (*c.* 25 kc./sec.) for 15 min. When the extract thus formed was recovered by removal of the solvent under reduced pressure in an atmosphere of dry oxygen-free nitrogen, it formed a black, free-running solid that was only very slightly soluble in boiling pyridine. The elementary composition of this material was practically identical with that of the original α-fraction, both being reduced to the pure coal basis.

The same result was afterwards recorded with several other coals ranging from lignitous to bituminous; the starting material (that is, the α-fraction) was in each case obtained by extracting the finely powdered coal with boiling pyridine in a Soxhlet apparatus for fourteen days.

These observations are of considerable interest. It has already been shown by Kiebler[1] that the yield of extract obtainable from a given coal is statistically related to the internal pressure of the solvent. The effects here described appear to form an extension of this generalization: they imply that the quantity of material which can be extracted from a coal varies with the total *energy* that is available for the detachment of molecules (or micelles[2]) from the coal lump or particle. They lead, however, to an important additional conclusion: theoretically, the supersonic effect may be connected with one of three mechanisms. Thus one may suppose either (1) that supersonic waves effect a breakdown of large molecules contained in coal, or (2) that they cause a *disruption* of individual coal micelles, or (3) that they bring about a *dispersion* of micelles in their entirety.

The first alternative can be discounted since supersonic waves do not in general effect a breakdown of molecules the molecular weight of which is less than about 10,000; molecular weights of this order have never been reported for coals. The second is improbable in view of information so far available about the micellar structure, behaviour and stability. There remains the third alternative, namely, the dispersion of micelles. This is supported by the observation[3] that coal extracts possess distinct colloidal properties, and if coupled with the fact that the extract formed in a supersonic field is itself only very slightly soluble in pyridine, suggests that coals simulate thixotropic substances; in other words, their pre-existing micellar structure can be disturbed by a sufficiently high energy input, but largely reconstituted when the cause of the disturbance is removed.

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λ-Mesons in Air Showers

In *Nature* of January 29, 1949 (p. 181), Prof. L. Jánossy and C. B. A. McCusker presented evidence for the existence of light mesons called 'λ-mesons' in the air showers of cosmic rays, and deduced several properties of these new particles. We think that the evidence has been misinterpreted and can be accounted for more simply without invoking new particles; and that mesons do not exist in the air showers—nor, probably, do they exist anywhere else.

The essential evidence presented by Jánossy and McCusker was that the number of 'penetrating' particles recorded under a lead shield was reduced by (24 ± 6) per cent when an *extra* lead shield, 1·7 cm. thick, was placed 50 cm. above the original absorber. Jánossy and McCusker do not state the thickness of their original absorber; but we conclude from their sketch of the apparatus and from their statement that the expriment was a repetition of a similar one by Miss Chaudhuri, that the thickness was 15 cm. or less.

We have found[1] that a comparable reduction in the number of particles penetrating the shield occurs independently of whether the extra absorber is placed far above the original shield or immediately on top of it, and that the particles that are absorbed are the photons and electrons of the air showers, rather than any kind of meson. W. W. Brown and A. S. McKay, who have studied air showers with a cloud chamber shielded by 15 cm. of lead, confirm that many of the particles that penetrate the shield are photons and electrons (results of investigation not yet published).

In considering the effectiveness of a lead shield in removing electrons and photons, it is frequently overlooked that the energy spectrum of the soft component in extensive showers is very different from that of the soft component observed independently of showers, and that the spectrum of the particles in the showers is about the same for the showers observed at sea-level as for the showers observed on high mountains. Also it is overlooked that each electron or photon of high energy that strikes the lead generates many low-energy photons of long range that may release electrons in counter walls under large thicknesses of lead[2]. Hence at least 20 cm. of lead is required to reduce the soft component of the showers to a level of intensity that is small compared with that of the penetrating particles.

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[1] Cocconi, G., Cocconi Tongiorgi, V., and Greisen, K., *Phys. Rev.*, **75**, No. 6 (1949).
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Deviation at Vertical Incidence in the Ionosphere

With regard to G. Millington's communication[1], we should like to point out that, so early as 1946, we directed attention to this phenomenon and set up the differential equation of the ordinary and extraordinary rays. We calculated the deviation for a vertical sounding made in Paris on 5 Mc./s. and found it equal to a few kilometres. We also suggested the use of this deviation for explaining the relative variation of amplitude of split echoes[2,3].

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[1] Millington, G., *Nature*, **163**, 213 (1949).
[2] Cotte, M., *C.R. Acad. Sci.*, **222**, 605 (1946).
[3] Cotte, M., Note preliminaire No. 96, Laboratoire National de Radioélectricité, Nov. 4, 1946.

I am grateful to Prof. M. Cotte for directing my attention to the fact that he has already published the explicit forms of the deviation due to the earth's magnetic field and discussed the order of the separation of the reflexion points and its effect on the relative fading of the ordinary and extraordinary waves. The forms of the deviation quoted by me were derived some years ago (though not yet published) from Booker's analysis. They are implicit in Booker's paper and were doubtless known to him when he originally discussed the phenomenon.

The main purpose of my note was to stress its implications in the interpretation of Pf records relative to the value of the gyro-frequency and the making of observations during an eclipse. In this connexion it is interesting to record that I have received a letter from Dr. L. V. Berkner in which he mentions the use that they have made of the effect to derive the horizontal gradient and changes therein in the ionosphere at the onset of a magnetic storm[1], and says: "We are very pleased to see your emphasis of this point as it relates to the interpretation of radio echo observations during solar eclipse. I had overlooked this point and feel quite certain that it will not only modify the interpretation of the observations somewhat, but will add to the power of the radio methods in drawing more general conclusions."

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1949 INTERNATIONAL GEOGRAPHICAL CONGRESS

THE International Geographical Congress, postponed from September last, was held at Lisbon during April 8–15 under the presidency of Prof. Emm. de Martonne. Thirty-four countries were represented, according to the list of members, among the seven hundred delegates and adherents. There were strong delegations from Brazil, the United States, France, Belgium, Switzerland, Italy, Spain and the Scandinavian countries, but the U.S.S.R. was not represented. Between thirty and forty attended from Great Britain—a widely representative group. The seven sections and the various commissions held their meetings in the palatial Higher Technical Institute, a new building in a commanding position in the modern north-eastern sector of Lisbon. Numerous social occasions, including a gala performance at the São Carlos Theatre, which the Portuguese organised superbly well and with most lavish hospitality, gave abundant opportunities for those international contacts which are perhaps the most valuable and lasting features of such congresses. The importance attached by the Portuguese hosts to the occasion was marked by the presence of the President himself at the opening ceremony held in the National Parliament Building.

Practically the whole of the work of the Congress was carried on in either French or English, and the discussions in the sectional meetings—usually well attended—proceeded with the utmost cordiality. Running through the whole work of the Congress was the realization, so marked in recent years, that geographical analysis and methods of survey have an important part to play in the solution of the great world problems of the day, that such an approach is an essential complement to economic and social analysis and can be carried on apart from political considerations. The whole atmosphere at Lisbon was scientific and non-political. Evidence of this modern development was afforded by the fifty or more papers read to the section of human geography on different aspects of rural life, modern developments of transhumance in relation to soil erosion, and in the whole section devoted to colonial problems, as well as in the appointment of commissions (the work of which continues between Congresses) to deal with physical planning, agricultural geography and the possibility of a world inventory in map form of land use and land resources. Practical issues were also to the forefront in the work of the commission on aerial photography and the study of industrial ports.

The actual Congress was preceded by an excursion, largely attended by the American delegation, and was followed by four alternative excursions to different parts of Portugal and one to Madeira. The guide-books prepared for the excursions, as well as the actual leadership, supplied excellent evidence of the high level reached by academic geographers in Portugal.

A feature of the Congress was the exhibition of cartography, which included notable displays of modern maps from many countries, ranging from the Vatican State to the United States. Whether through lack of appreciation of the occasion or parsimony of the Treasury, it is a tragedy that Great Britain was not officially represented at this exhibition, though few maps attracted more attention or comment than the National Planning Series (1 : 625,000) displayed in the cartography section to illustrate one of the papers.

At the closing session the invitation of the United States was accepted for the next Congress to be held in 1952. Prof. de Martonne was elected honorary life president of the International Geographical Union, while Prof. G. B. Cressey (Syracuse University, United States) becomes president, with Mlle. Lefèvre (Belgium), Prof. Almagia (Italy), Prof. Orlando Ribeiro (Portugal—the organiser of the Lisbon Congress), Prof. Hans Boesch (Switzerland), Prof. L. Dudley Stamp (Great Britain), Prof. Leite de Castro (Brazil) and Prof. George Kuriyan (India) as the vice-presidents who constitute the executive committee. With the election of Prof. G. H. T. Kimble (McGill University, Canada) as secretary-general the secretariat will move from Brussels to Montreal.

The International Union normally contacts the National Geographical Committee in each adhering country, and the conference proceedings brought out the difficulties which may result where such a national committee is divorced from the main geographical societies. The position in Great Britain is particularly anomalous. Geographers have not yet been recognized, as such, by election to the Royal Society, yet the National Committee is a committee of the Royal Society and the chairman must be a Fellow of the Society. As a result, the British delegation seemed to lack the coherence so markedly displayed by the American.

L. DUDLEY STAMP

A MOUNTAIN CENTRE OF GENETICS IN THE APPENNINES

By PROF. CARLO JUCCI

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THE genetical centre of the Italian National Council of Research, which is associated with the "L. Spallanzani" Institute of Zoology of the University of Pavia, is organising a Mountain Section in the Appennines on Mount Terminillo, at a height of 1,800 m. This Mountain Centre of Genetics is designed for the investigation of those plants and animals which are particularly suited for the study of processes of racial and specific differentiation; that is, of micro-evolution, according to the principles and methods of modern population genetics.

The mountain environment, with its characteristic complex of geographical, climatic and ecological conditions, imposes peculiar adaptations on animals and plants, and the genetical basis of these adaptations is particularly significant when it is studied in comparison with corresponding systematic entities inhabiting the plains or different altitude levels. The exploration of the amplitude of phenotype variations consequent on 'transfer' from one habitat to another (and this applies also to culture in nutrient solutions) and the exploration of the potentialities of genotype variation by induction of mutations with X-irradiation should extend the comparative analysis and furnish data for an interpretation of evolutionary mechanisms and modes.

From this central position on Mount Terminillo it will be an easy matter to have chains of small experimental stations going up to the crest (2,200 m. high —a modest altitude but the highest in the Appennines except for Mount Gran Sasso) and toward the valley of Rieti (where the N. Strampelli Experimental Station for Wheat Culture is situated).

The Mountain Centre is still in a preliminary phase of organisation, since the building which will constitute the *ubi consistam* of the Institute with its laboratories and its rooms for guest research workers is just now being restored from war damage and adapted to new functions. The Italian Government has leased the building for six years to the University of Pavia, and the Ministry of Public Works has given the funds for restoring it. The town of Rieti, besides giving up in favour of the Centre every right to the building, which is situated on its own land, has granted several hectares of surrounding ground to be used for experimental fields and other needs of the Centre. The National Council of Research has helped by adding to the annual grant to the Centre of Genetics the sum of 100,000 lire in order to pay the rent and upkeep of the building. A call will be made to Italian industries asking for generous gifts in order to furnish the laboratories and the rooms for the guest research workers, who may be expected to stay at the Centre for some months during the season suitable for their own particular researches, working on plant or animal genetics. The exploration of the flora of Mount Terminillo has been already undertaken, and a herbarium, systematic and topographical schedules, and so on, have been established. A parallel exploration of the fauna, particularly the insects, is planned. The investigation of the flora and fauna is an indispensable preliminary phase, to which biologists specializing in various systematic groups will be asked to contribute. On the basis of such investigations, the animals and plants on which genetical research and the study of evolution can be most fruitfully carried out will be selected.

The scope of the Institute is fundamentally a scientific one in the field of general and theoretical biology; but without doubt the results of the research work will prove important also for agriculture, and collaboration is already planned with other institutions for such purposes as applications to sylviculture, forage problems, and so on.

The fitting up of the Institute, and even more, its activities and functions, will require substantial financial support. But confidence prevails with regard to the possibility of securing adequate support, since the interest of the undertaking is quite clear, and the Institute might well assume an international character. The importance of the general problems which the Institute proposes to investigate in its experimental activities, the structure of the Institute itself, founded on co-operation between research workers specializing in various groups of plants and animals, the fact that in Europe there is no institute with an organisation corresponding to the system of the three transplant stations that the Carnegie Institution of Washington supports in California (located at Stanford University near the coast, at Mather half-way up the Sierra Nevada and at Timberline near the crest of this mountain range) —these and other conditions make the Mountain Centre of Genetics suitable for consideration as one of the international institutes of research, the establishment of which the Economic and Social Council of the United Nations is prepared to encourage.

SHORT-PERIOD VARIATIONS IN THE IONOSPHERE

By G. H. MUNRO

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DURING the years 1938 and 1939 fixed-frequency pulse observations were being used to record continuously the virtual height and echo intensity of reflexions from the *F*-region at two frequencies close to the vertical penetration frequency for the region. It was noticed that, in the daytime, the penetration frequency often showed quasi-periodic fluctuations with periods of the order of half an hour. The magnitude of the fluctuation was variable but frequently of the order of 1 Mc./s. from maximum to minimum.

In endeavouring to correlate these effects with changes in *h'f* records then being taken at Mount Stromlo, Canberra, Mr. A. J. Higgs, of the Commonwealth Observatory, found that they appeared to be initial indications of ionization changes which showed a progression down the *h'f* curve from the higher to the lower frequencies. At this stage the investigation was interrupted by diversion of staff to war-work.

During the past year an investigation of horizontal movements in the *F*-region was undertaken[1], and ionization changes were observed which appeared to have a progression in a horizontal direction. It was also observed that these were frequently quasi-periodic in nature with periods of the same order as in those mentioned above.

By taking *h'f* records in conjunction with the three-point observations, we have now been able to establish quite definitely that all these effects are due to local fluctuations in ionization in the *F*-region, which show both a vertical progression downwards and a horizontal progression.

The *h'f* recorder, which was kindly made available for a short period by the Radiophysics Laboratory of the Council for Scientific and Industrial Research, was located at Liverpool (point 4 in my previous communication, ref. 1), and observational runs were taken continuously (repeating every two minutes), simultaneously with observations on the three-point system.

A good set of records was obtained on June 22, 1948. Fig. 1 shows a set of *h'f* tracings illustrating the sequence of events during 1230–1314. It will be seen that kinks appear in the *h'f* curves and move down from the higher to the lower frequencies. These imply corresponding variations in the vertical ionization gradient.

The sequence of events is as follows. At 1230 the ordinary ray curves look to be approximately what would be expected from a regular parabolic gradient of ionization. From 1230 to 1242 the penetration frequency falls steadily and the virtual height increases for frequencies near penetration. At 1242 a sharp maximum of virtual height appears a little below the penetration frequency. The visible disturbance is thus an increase of virtual height above the normal value for a particular frequency. The maximum of this disturbance progresses down the *h'f* curve with time, being obvious again at 1314 as the virtual height maximum at 6 Mc./s.

The curve for the extraordinary ray shows similar changes, but later in time, causing cross-over points of the two rays which also move down the curves.

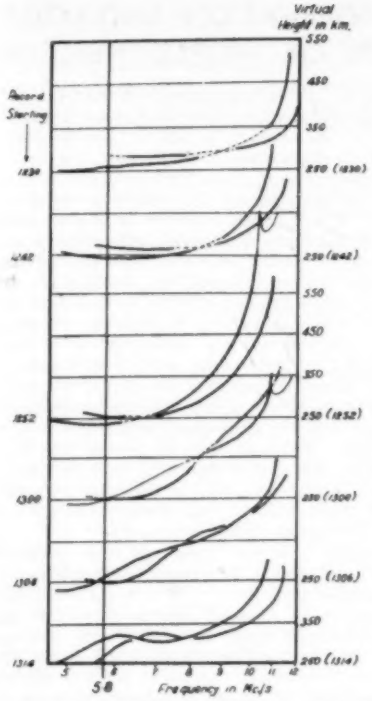

Fig. 1. Downward progression of ionospheric disturbances on *h'f* curves. (Point 4, June 22, 1948)

The record on a fixed frequency of 5·8 Mc./s. will show the changes in virtual heights of the two components at this frequency, giving a pattern similar to that of Fig. 4 in my previous communication (ref. 1).

To examine the nature of the disturbance more carefully, we have used the method outlined by Manning[2] to convert the virtual height/frequency curves to true height/frequency curves and so derive the true height/ionization density curves. From these we are able to plot changes in ionization density with time for any actual height. A set of such curves is shown in Fig. 2 for the same period as shown in Fig. 1.

It will be seen that at each height the ionization passes through a maximum and then a minimum, and that these maxima and minima progress downward at a substantially uniform rate of approximately 3·5 km. per minute.

The apparent horizontal velocity of the disturbance at Sydney as determined from the three-point system on 5·8 Mc./s. was approximately 7 km. per minute.

In order to determine the lateral extent of these effects we have examined the *h'f* records for Canberra for the same day. These show very similar effects to those observed at Sydney, but occurring approximately 15 min. earlier.

The bearing of Sydney from Canberra is 37° (E. of N.), and the mean direction of apparent horizontal movement observed at Sydney on the three-point system was 28°. The distance is 237 km., so that the apparent horizontal velocity deduced from the Canberra–Sydney time difference is approximately 16 km. per min., compared with 7 km. per min. deduced from the Sydney three-point observations.

We have examined also the Brisbane records for the same day (bearing approximately 10°, and distance approximately 700 km.). Similar effects do appear there, but, owing to the distance, correlation cannot be established as certainly as in the case of Canberra.

Considering the simplest explanations, the effects observed could be due to the progression of a pressure wave with the wave-front having an appropriate tilt with reference to the earth's surface. The observed velocities are of the right order for this. They could also be the result of an atmospheric drift with a varying ionization gradient superimposed on it. Further investigations are in progress to enable better assessment of the probabilities.

The difference in the apparent horizontal velocities as deduced from (*a*) the Canberra–Sydney time-difference, and (*b*) the three-point observations at Sydney, could be explained by variations in velocity, direction or tilt over the intervening distance.

Disturbances of this type appear to occur on most days at all sites from which suitable records are available to us. It seems most important, therefore, that examination of apparent velocities should be made, for as many locations as possible, to establish the extent and variations of the effects with the view of establishing the origin of the disturbances.

These disturbances are of direct practical interest in connexion with radio propagation via the ionosphere. The continually varying difference in paths

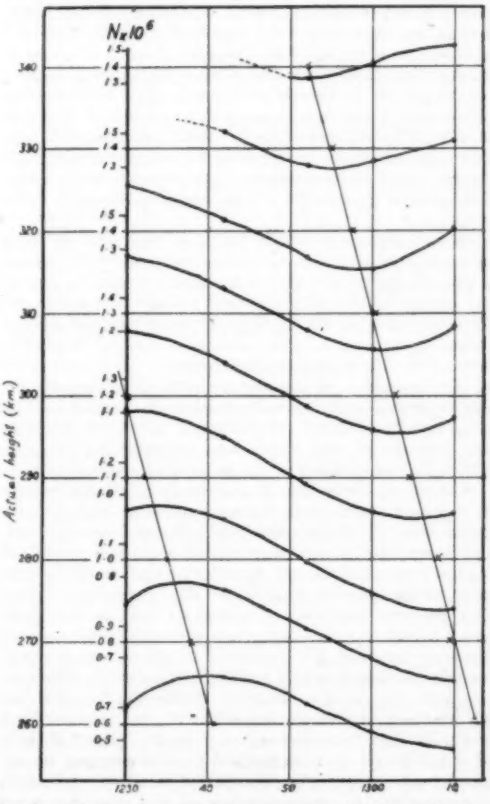

Fig. 2. Changes in ionization at various actual heights. (Point 4, June 22, 1948)

of the ordinary and extraordinary rays causes interference beats between the two which results in severe fading in receivers. In addition, it is found that the disturbances cause large variations in the strength of the returned signal.

The investigations are continuing, and will be reported more fully elsewhere.

This work has been carried out in the Electrical Engineering Department of the University of Sydney as part of the programme of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research, and is published with the consent of the Council.

The keen interest of Sir John Madsen, chairman of the Board, and the assistance of the staff of the Sydney Section, are gratefully acknowledged.

[1] *Nature*, **162**, 886 (1948).
[2] *Proc. Inst. Rad. Eng.* (Nov. 1947).

CONSTITUTION OF THE TERRESTRIAL PLANETS

IN a paper, "On the Constitution of the Terrestrial Planets", by W. H. Ramsey (*Mon. Not. Roy. Astro. Soc.*, **108**, 5; 1948), it is suggested that the earth's core and mantle are not chemically distinct. Seismological data show that the earth has a central core which occupies about one-sixth of its total volume and contains about one-third of its mass, and it has been generally assumed that the material of this core is an alloy of iron and nickel. The core is mainly responsible for the earth's high mean density —the highest in the solar system. The high masses of the four great outer planets have enabled them to retain hydrogen and other volatile substances, and this explains their comparatively low densities; but the fact that the terrestrial planets have mean densities smaller than that of the earth presents a difficulty.

One explanation would be that the planets were originally of different compositions; but this theory is impossible to reconcile with any current theory of the origin of the solar system. The only other explanation is that the earth's core and mantle are not chemically distinct, and Ramsey's analysis supports this view. He assumes that the hydrostatic pressure at the boundary of the earth's core depends only on the chemical and crystallographic properties of the substances concerned, which must be true if the core and mantle of the earth are respectively metallic and molecular phases of the same chemical substance.

Assuming, then, that the pressure at the boundary of the core is the same for all terrestrial planets, the mean densities of the terrestrial planets are computed, and these are in good agreement with the empirical results; the calculated density of the moon is also in excellent agreement with the observed value. The greatest discrepancy occurs in the case of Mars, being about ten per cent; but this and other smaller discrepancies can be explained if allowance is made for the tendency of the heavier elements to gravitate towards the earth's centre. While the theory can account for the mean densities of the planets in a manner which is satisfactory from the point of view of cosmogony, it is admitted that it cannot be regarded as completely established until the pressure characteristic of the boundary of the core has been calculated from atomic theory.

CONSERVATION AND UTILIZATION OF WORLD RESOURCES

THE provisional programme of the United Nations Scientific Conference on the Conservation and Utilization of Resources to be held at Lake Success during August 17–September 6, 1949, has now been issued to member Governments for comment, and in particular for suggestions for addition or deletion of topics. The primary concern of the Conference is with the particular application of science to the management and use of resources, and the knowledge of numerous related sciences will be brought into full play on single problems so as to facilitate complete and not partial solutions. The plenary meetings will discuss techniques for assessing and classifying resources; for protecting resources, whether by reducing waste in mineral resources, by control of injurious insects or diseases, or by prevention of soil erosion; and for increasing production; as well as techniques of special interest to the less developed countries, the special scientific and technical needs of such countries, and experience in the interrelated application of such techniques, for example, as the Tennessee Valley Authority.

A section will hold meetings to consider the inventory and survey of forests, control of fire, insects and diseases in forests, sylvicultural techniques, the organisation of research and education in forestry, forest administration, manufacturing processes for wood, and the utilization of wood-waste and new products from wood. Another section will consider the appraisal of water resources, watershed management, multiple-purpose reservoirs, pollution, salinity and sedimentation of water supplies, methods of controlling floods, the relation of soils to irrigation and drainage, and irrigation and drainage technique generally.

Methods and techniques for the conservation and use of soil, soil productivity and fertilizers will be discussed in a third section, which will also consider research programmes and surveys in this field, the settlement of new lands, new crops and plant breeding as techniques for conservation, cropping systems, protection of crops and grasslands against weeds, diseases and pests, storage and preservation of agricultural products, adaptation of livestock to environment and its improvement through breeding, the feeding of livestock, diseases and pests of livestock, farming systems in relation to soil conservation, the condition of grazing lands, and seeding of natural grazing lands. A fourth section will consider such problems of fisheries and wild life as changes in abundance of marine populations, the utilization and management of marine fishery resources as well as inland fisheries, cultivation of aquatic animals, the place of fish and wildfowl conservation in the balanced development of resources, and the control of injurious animals.

A fifth section, on fuels, will consider techniques of producing coal, oil and gas, the recovery of secondary oil, synthetic fuels, and the utilization of coal resources, including by-products. The sixth section, on power, will consider the various methods of power production, including steam and Diesel-electric plants, the gas turbine, hydro-electric power and the wind turbine, transmission, distribution and utilization problems. The seventh section, on mineral resources, will consider the measurement of such resources, methods of prospecting or discovery, new

mining and milling techniques, smelting and refining technology, developments in the fabrication of metals, including powder metallurgy and diecasting, methods of conservation in the use of minerals, including the use of substitutes, the reclamation of metals and the administration of mineral industries.

On the recommendation of the Committee on Overseas Scientific Relations, His Majesty's Government has invited the undermentioned to represent the United Kingdom at the Conference: Dr. S. Buchan, Geological Survey and Museum; Dr. R. A. E. Galley, Agricultural Research Council; Mr. G. M. Graham, Ministry of Agriculture and Fisheries; Dr. John Hammond, School of Agriculture, University of Cambridge; Sir Harold Hartley, chairman of the British National Committee, World Power Conference; Dr. Alexander King, Office of the Lord President of the Council; Dr. Isabella Leitch, director of the Commonwealth Bureau of Animal Nutrition; Mr. J. Macdonald, Forestry Commission; Mr. V. K. Maitland, Foreign Office; Dr. W. F. P. McLintock, director of the Geological Survey and Museum; Dr. A. Muir, Soil Survey for England and Wales; Sir William Ogg, director of Rothamsted Experimental Station; Lord Robinson, chairman of the Forestry Commission; Prof. L. Dudley Stamp, London School of Economics; Dr. H. Sutton, Ministry of Supply; Dr. F. N. Woodward, director of the Scottish Seaweed Research Association; Mr. A. N. Duckham, agricultural attaché, British Embassy, Washington; Dr. W. A. Macfarlane, scientific attaché, British Embassy, Washington; Mr. E. E. Saben-Clare, Colonial attaché, British Embassy, Washington; and a representative from the National Coal Board.

WEST AFRICAN CACAO RESEARCH INSTITUTE

POPULAR interest has been aroused in the 'swollen shoot' disease of cacao; but it is only one of many virus troubles which are being investigated. The annual report for 1947–48 of the West African Cacao Research Institute at Tafo, Gold Coast (Crown Agents for the Colonies, 4 Millbank, London, S.W.1. 1949. 5*s*.), reveals extremely complex relations between numerous viruses, particularly in the Western Province.

The general situation is somewhat similar to that of potato viruses in Great Britain. Cacao virus A (swollen shoot), for example, cannot attack hosts which are already infected with strains H and K or attenuated strains of itself, whereas virus M forms a symptom complex with it. Viruses C, D, E, F, G, J and N confer no protection against virus A, but do not form symptom complexes. On one experimental area, swollen shoot increased from 31 per cent infection in August 1945 to 64 per cent in 1947. Yield dropped from 41,771 pods in 1945 to 24,569 in 1947. The virus also reduced the root system of young seedlings, and can infect several wild hosts. It is not transmitted mechanically, but by various species of mealybug. *Pseudococcus njalensis* is the commonest of these vectors. Considerable work has been done on the ecology of vectors and on their relations with ants. Control involves the removal of trees showing swollen shoot symptoms, though this practice does not commend itself strongly to the owners of plantations.

Capsid damage on cacao is often severe, and a good amount of work on biology and control of these pests has been accomplished. Numbers of the two commoner species *Sahlbergella singularis* and *Distantiella theobroma* were, however, very low in 1947–48. D.D.T. emulsions provide a useful degree of control on young plants. The senior soil scientist of the Institute was seconded to the Oil Seeds Mission for the survey of areas suitable for ground-nuts. The Section of Chemistry has, however, made a useful survey of the cacao butter content of several new strains. Two selections of Herrania cacao imported from Trinidad yielded about 64 per cent of cacao butter, as against the average of 52 per cent for the usual West African varieties.

Mycological work has included studies of *Calonectria rigidiuscula* and *Botryodiplodia theobromæ*, which are associated with capsid damage and dieback. Species of *Fusarium* have also been found to cause damping-off of cacao seedlings. The results of trials of various methods of management are also given in the report, which, indeed, portrays a large amount of useful work.

J. GRAINGER

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, May 23

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 8.15 p.m.—Prof. R. E. M. Wheeler: "Geographical Aspects of Romano-Buddhist Art".

Tuesday, May 24

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5 p.m.—Dr. John Rickman: "The Technique of Interviewing".

UNIVERSITY OF LONDON (at Bedford College, Regent's Park, London, N.W.1), at 5.15 p.m.—Prof. A. Michotte (Louvain): "Why the Physical World Appears to Us as it Does".* (Further Lectures on May 26 and May 27.)

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Prof. H. J. Fleure, F.R.S.: "Some Biological Considerations in Social Evolution".*

INSTITUTE OF SOCIOLOGY (at the Royal Institute of British Architects, Portland Place, London, W.1), at 5.30 p.m.—Mrs. Monica Felton: "New Towns".

Tuesday, May 24—Friday, May 27

TEXTILE INSTITUTE (at Dublin)—Annual Conference ("The Industrial Application of New Knowledge").

Wednesday, May 25

SOCIETY OF CHEMICAL INDUSTRY, FOOD GROUP (joint meeting with the Royal Sanitary Institute, at the Astoria Cinema, Gloucester Place, Brighton), at 10 a.m.—Discussion on "The Care and Preservation of Fish as Food".

INSTITUTE OF METALS (at the Royal Geographical Society, Kensington Gore, London, S.W.7), at 6 p.m.—Sir Edward Appleton, F.R.S.: "The Organisation and Work of the Department of Scientific and Industrial Research" (Annual May Lecture).*

ROYAL STATISTICAL SOCIETY, NORTH-EASTERN GROUP of the INDUSTRIAL APPLICATIONS SECTION (at the Chemical Industries Club, 18 Lovain Place, Newcastle-upon-Tyne), at 6.30 p.m.—Mr. A. W. Swan: "The Organisation and Operation of a Statistical Section in Heavy Industry".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Dr. A. H. Cook: "Chromatographic Separation of Natural Compounds".

Thursday, May 26

INSTITUTION OF ELECTRONICS, NORTH-WEST SECTION (in the Reynolds Hall, College of Technology, Manchester), at 6.30 p.m.—Dr. A. C. B. Lovell: "Radio Astronomy".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS, BIOLOGICAL METHODS GROUP (in Room 3, Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 6.30 p.m.—Scientific Papers.

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 7.15 p.m.—Scientific Papers.

Friday, May 27

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Geophysical Discussion.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER (with good honours degree) IN MATHEMATICS, to the standard of the London General Degree and Higher National Certificate in Engineering, at the Monmouthshire Technical College, Crumlin—The Director of Education, County Hall, Newport, Mon. (May 28).

BIOCHEMIST (non-medical)—The Director of the Pathological Laboratory, General Hospital, Middlesbrough (May 28).

LECTURER IN MATHEMATICS, to teach up to B.Sc. General Degree standard—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (May 28).

BIOCHEMIST (non-medical)—The Pathologist, Royal Infirmary, Sunderland (May 28).

SENIOR ASSISTANT FOR PHYSICS—The Principal, Municipal Technical College, Halifax (May 28).

ASSISTANT LECTURER IN THEORETICAL PHYSICS—The Registrar, King's College, Strand, London, W.C.2 (May 30).

CHEMIST to undertake work on problems connected with the Knitting Industry—The Secretary, Hosiery Research Council, 4 First Avenue, Sherwood Rise, Nottingham (May 31).

ASSISTANT LECTURER IN METALLURGY—The Registrar, University College, Singleton Park, Swansea (May 31).

CHIEF CONSERVATION AND EXTENSION OFFICER, Southern Rhodesia—The Secretary to the High Commissioner for Southern Rhodesia, 429 Strand, London, W.C.2 (May 31).

DEMONSTRATOR IN THE DEPARTMENT OF ENTOMOLOGY—The Assistant Dean, London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1 (May 31).

HENRY GEORGE PLIMMER FELLOWSHIP for research in morbid anatomy, histological anatomy, chemical pathology, protozoology, bacteriology and allied subjects in either zoology, medicine or botany—The Registrar, Imperial College of Science and Technology, Prince Consort Road, London, S.W.7 (June 1).

COKE RESEARCH FELLOWSHIP provided by the British Coke Research Association—The Registrar, The University, Sheffield (June 1).

EXPERIMENTAL OFFICER at the Fisheries Laboratory of the Ministry of Agriculture and Fisheries, Lowestoft—The Secretary, Civil Service Commission, 27 Grosvenor Square, London, W.1, quoting No. 2545 (June 1).

ELLISON FELLOWSHIPS for postgraduate research in Chemistry or Physics—The Registrar, The University, Sheffield (June 1).

LECTURER IN ZOOLOGY—The Secretary, Queen's University, Belfast (June 6).

GUIDE-LECTURER IN THE GEOLOGICAL MUSEUM (Museum of Practical Geology), South Kensington—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2551 (June 8).

PRINCIPAL SCIENTIFIC OFFICERS (2) for (a) road safety work and (b) technical administrative duties, SENIOR EXPERIMENTAL OFFICERS (3) for full-scale experimental work on roads, and an EXPERIMENTAL OFFICER for research on soil mechanics, at the Road Research Laboratory, Harmondsworth, Middx.—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2554 (June 8).

PATHOLOGICAL TECHNICIAN (male) in the West Midland Forensic Science Laboratory, Birmingham, under the Home Office—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2553 (June 8).

PROFESSOR OF INSTRUMENT TECHNOLOGY at the Military College of Science, Shrivenham, Swindon, under the War Office—The Secretary, Civil Service Commission, 27 Grosvenor Square, London, W.1, quoting No. 2556 (June 10).

READERSHIP IN BOTANY at Birkbeck College—The Academic Registrar, University of London, Senate House, London, W.C.1 (June 10).

LECTURER IN PURE OR APPLIED MATHEMATICS—The Secretary, Queen's University, Belfast (June 14).

PRINCIPAL SCIENTIFIC OFFICER at a Ministry of Supply Research and Development Establishment in Lancs, to lead an organic research section—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2 quoting F.306/49A (June 14).

CHEMISTS or ENGINEERS (Experimental Officer grade) in a Ministry of Supply Research and Development Establishment near London, for work involving design and use of electronic and other instruments required for investigating combustion and allied processes—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.309/49A (June 15).

ASSISTANT LECTURER IN BIOCHEMISTRY—The Registrar, The University, Leeds (June 15).

GEOLOGISTS (about 10), and SENIOR GEOLOGISTS (one or two) at the Geological Survey and Museum—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2547 (June 17).

SENIOR and JUNIOR FELLOWSHIPS—The Director, Atomic Energy Research Establishment, Harwell, Didcot, Berks (June 18).

DEMONSTRATOR or ASSISTANT LECTURER IN THE DEPARTMENT OF GEOLOGY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (June 20).

FOOD INDUSTRIES RESEARCH STUDENTSHIP—The Secretary, Queen's University, Belfast (June 21).

LECTURER or SENIOR LECTURER IN APPLIED CHEMISTRY (Chemical Engineering), LECTURERS (3) IN THE CIVIL ENGINEERING DEPARTMENT, LECTURERS (2) IN THE MECHANICAL ENGINEERING DEPARTMENT, LECTURERS (2) IN THE ELECTRICAL ENGINEERING DEPARTMENT, and a PROFESSOR OF ECONOMICS, at Canterbury University College, Christchurch, New Zealand—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (June 22).

DRILLING ENGINEER to the Sudan Public Works Department, for the control and operation of the drilling plant and well-sinking activities under the direction of the Government Geologist—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Drilling Engineer' (June 30).

SENIOR LECTURER IN GEOLOGY, and a SENIOR LECTURER IN EDUCATION, in the University of Otago, Dunedin, New Zealand—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (June 30).

JUNIOR LECTURER or LECTURER IN PHYSICS at the University of Hongkong—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (July 1).

SENIOR LECTURER OR LECTURER IN THE DEPARTMENT OF AERONAUTICS—The Head of the Aeronautics Department, Imperial College of Science and Technology, South Kensington, London, S.W.7.

TECHNICIAN as research assistant—Biochemistry Department, South Parks Road, Oxford.

GRADUATE (physics, mathematics, chemistry) for combustion and heating problems—The Assistant Secretary, British Coal Utilisation Research Association, Randalls Road, Leatherhead, Surrey.

SENIOR TECHNICIAN—The Medical Superintendent, Milford Sanatorium, Milford, Surrey.

CHEMISTS and PHYSICISTS on the research and technological staff—The Director, Paint Research Station, Waldegrave Road, Teddington, Middx.

DIRECTOR OF THE WEST AFRICAN AGRICULTURAL AND FORESTRY RESEARCH ORGANISATION—The Under-Secretary of State, Colonial Office, Research Department, Sanctuary Buildings, Great Smith Street, London, S.W.1.

PHYSICIST to the Radiotherapy Centre at the Derbyshire Royal Infirmary—The Secretary, Derby Area No. 1 Hospital Management Committee, Babington Lane, Derby.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Film Association. Notes for the Secretaries of Medical Societies on Organising Medical Film Programmes. Pp. 12. (London: Scientific Film Association, 1948.) 1s. [2911

Ministry of Works. Birds in London: Report by the Committee on Bird Sanctuaries in the Royal Parks (England and Wales), 1939–47. Pp. iv+28. (London: H.M. Stationery Office, 1948.) 9d. net. [2911

University Development from 1935 to 1947: being the Report of the University Grants Committee. Pp. 106. (London: H.M. Stationery Office, 1948.) 2s. net. [212

Department of Scientific and Industrial Research: Radio Research. Special Report No. 16: A Method of Determining the Polar Diagrams of Long Wire and Horizontal Rhombic Aerials. By W. R. Piggott. Pp. iv+39. (London: H.M. Stationery Office, 1948.) 9d. net. [712

British Standard 1482: 1948. Home-produced Technical Tallow. Pp. 20. 2s. 6d. net. British Standard 1483: 1948. Home-produced Technical Bone Grease. Pp. 22. 2s. 6d. net. (London: British Standards Institution, 1948.) [712

Annual Report of the Central Office of Information for the Year 1947–48. (Cmd. 7567.) Pp. 56. (London: H.M. Stationery Office, 1948.) 1s. net. [812

Wool Knowledge: the Journal of Wool Education. Vol. 1, No. 1, Autumn 1948. Pp. ii+22. (London: International Wool Secretariat, 1948.) [812

Other Countries

Government of India: Ministry of Agriculture. The Forest Research Institute and Colleges (its Scope and Functions). Pp. iv+21+10 plates. (Dehra Dun: Forest Research Institute, 1948.) [2911

Indian Forest Records (New Series). Utilization, Vol. 4, No. 3: Some more Commercial Timbers of India. By K. A. Chowdhury and S. S. Ghosh. Pp. ii+25+7 plates. (Delhi: Manager of Publications, 1947.) 1.10 rupees; 2s. 6d. [2911

Annals of the New York Academy of Sciences. Vol. 51, Art. 1: Newer Synthetic Analgesics. By M. L. Tainter, H. J. Anslinger, R. C. Batterman, R. N. Bieter, S. Bogolub, K. K. Chen, N. B. Eddy, L. Glassman, B. B. Hershenson, S. A. Hirsh, R. W. Houde, H. Isbell, E. H. Jenney, J. S. LaDue, L. C. Miller, E. E. Nelson, C. C. Pfeiffer, L. H. Rasmussen, E. A. Rovenstine, M. H. Seevers, L. F. Small, R. R. Sonnenschein and F. F. Yonkman. Pp. 174. (New York: New York Academy of Sciences, 1948.) 2.75 dollars. [3011

UNESCO Science Co-operation Office, Middle East. List of Scientific Papers published in the Middle East (received by this Office up to 1st August, 1948). No. 2. Pp. 65. (Cairo: UNESCO Science Co-operation Office, 1948.) [3011

L'Activité de la Commission Géodésique Baltique pendant les années 1944–47. Pp. 118. (Helsinki: Commission Géodésique Baltique, 1948.) [212

University of Travancore: Department of Research. Report for the Septennium 1939–1946. Pp. x+594+11 plates. (Trivandrum: University of Travancore, 1948.) [612

West African Cacao Research Institute. Annual Report, April 1947 to March 1948. Pp. 85. (Tafo: West African Cacao Research Institute; London: Crown Agents for the Colonies, 1948.) 5s. [612

Sangre. Revista Organo Oficial de la Sociedad Chilena de Transfusión y Hematología. Vol. 1, No. 1, Mayo-Agosto 1948. Pp. 80. (Santiago: Sociedad Chilena de Transfusión y Hematología, 1948.) Annual subscription (3 Nos.), 6 U.S. dollars. [612

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau Central de Magnétisme terrestre. Fondées par Ch. Maurain et publiées par les soins de J. Coulomb. Tome 23. Pp. ii+94. (Paris: Presses universitaires de France, 1948.) [812

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Wigmore Consistometer T381 to Determine Workability of Concrete on the Site. Pp. 4. (London: A. Macklow-Smith, Ltd., 1948.)

Hot Water to Measure Instantly at Selected Temperatures in Measured Quantities. Pp. 4. (London: Ascot Gas Water Heaters, Ltd., 1948.)